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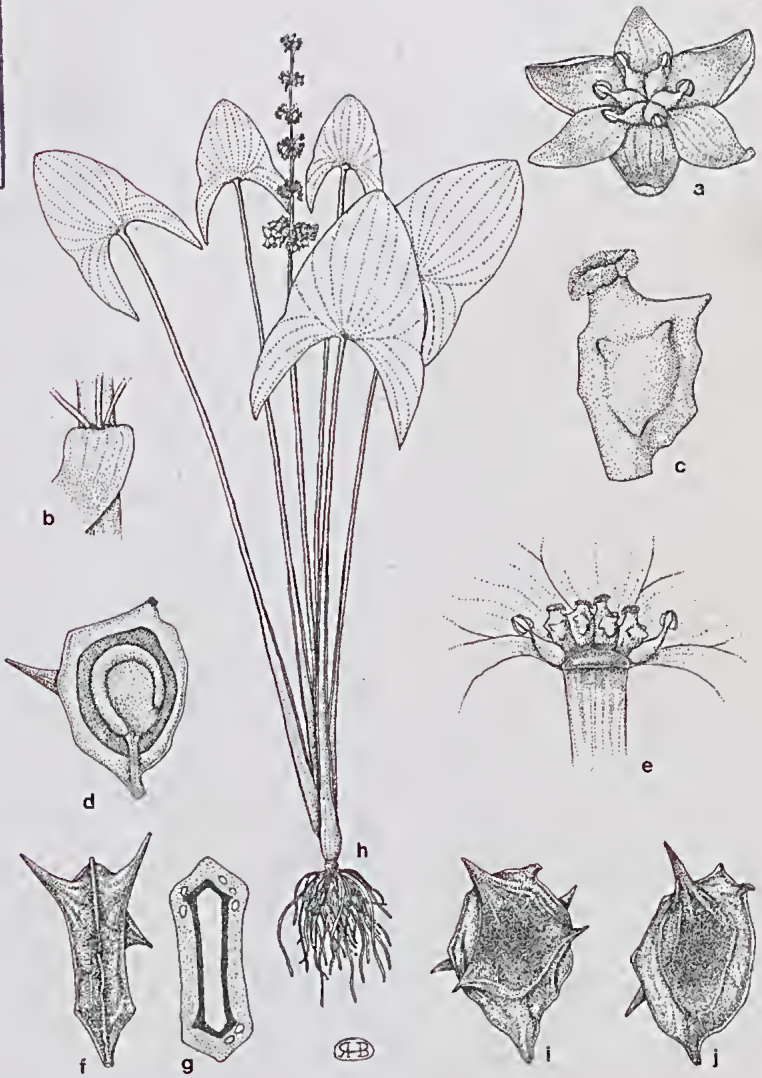

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In honour of Helen Aston a renowned taxonomist of aquatic plants. This year, 2008, marks 50 years of her association with the National Herbarium of Victoria. She wrote and illustrated the first comprehensive book on Australian water plants.

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A conspectus of high-country *Craspedia* (Asteraceae: Gnaphalieae) of mainland south-eastern Australia

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a 241617

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Introduction

The genus *Craspedia* G.Forst. comprises at least 45 species and is found throughout much of Australia and New Zealand. There is a concentration of species in the high mountain areas of south-eastern Australia and these are a major component of the annual summer floral display there. Species of *Craspedia* have been noted for the plasticity of many of their vegetative and floral characters and their propensity to hybridise (Costin *et al.* 1979, 2000; Everett & Thompson 1992). It is undoubtedly for this reason that most taxa in Australia were known as species aggregates until recently (Everett & Thompson 1992; Everett & Doust 1992).

In previous descriptions of high-country *Craspedia*, key diagnostic characters were leaf colour and shape, and flower colour (Everett 1999; Everett & Doust 1992). During recent field work for the revision of the *Kosciuszko Alpine Flora* (Costin *et al.* 2000) and the longer-term task of establishing a classification of treeless plant communities (McDougall & Walsh 2007), it became obvious that with the exception of white- to cream-flowered species, flower colour was a poor primary character for distinguishing species in high-country vegetation. We have attempted to employ the keys available since the description of several new alpine *Craspedia* by Everett and Thompson (1992), but have encountered difficulties due in part to variability in flower colour and interpretation of old or incomplete herbarium specimens. Further, there is no comprehensive account of the group, with previous works dealing with only part of the geographic range (e.g. New South Wales – Everett & Doust 1992; Kosciuszko National Park – Costin *et al.* 2000; Victoria – Everett 1999). Since 1992 we have attempted to equate our field observations with herbarium material and published species circumscriptions. This has led us to re-evaluate the various treatments of the high country species of *Craspedia* and to construct a key that we believe provides a more satisfactory means for identification across the range of the species. This key is offered here. It includes a species previously outlined as *Craspedia* sp. B (*sensu* Costin *et al.* 2000), formalised here as *Craspedia adenophora*.

Abstract

A reassessment is presented of previous treatments of the 11 species of *Craspedia* G. Forst. recorded from high-montane to alpine areas of south-eastern mainland Australia, with brief notes on the distribution and habitats of each species. A revised key to the species of this area is provided. A new species, *Craspedia adenophora* K.L. McDougall & N.G. Walsh, is described.

Muelleria 26(2): 3-10 (2008)

Revised key to high country *Craspedia* of the south-eastern Australian mainland

1 Florets white or pale cream 2

1: Florets yellow or orange 3

2 Leaves broad, more than 5 mm wide, green and glabrous except for occasional hairs on margins; Kosciuszko National Park endemic ..... ***C. leucantha***

2: Leaves narrow, less than 5 mm wide, covered with long fine hairs ..... ***C. alba***

3 Leaves discolorous, very sticky to the touch (and often smelling of mouldy orange), the upper surface dark green with dense microscopic subsessile or stalked glandular hairs, the lower surface silvery-grey with dense, long, loosely-appressed woolly hairs and glandular hairs; florets generally yellow (rarely orange) ..... ***C. adenophora***

3: Leaves not discolorous, or if slightly so, then without dense glandular hairs; flowers yellow or orange 4

4 Leaves wholly or partly grey- or white-woolly on the lamina (scape leaves sometimes glabrescent) 5

4: Leaves green, pubescent (with long multi-septate hairs), scabrous or ±glabrous (sometimes conspicuously woolly on the margins) 7

5 Leaves with variably woolly indumentum which often appears as though the woolly hairs have been shed and persist only in tufts or patches, or the indumentum sometimes confined to the marginal area and/or the midrib on the abaxial surface ..... ***C. hybrid*** (see notes re *C. maxgrayi* below)

5: Rosette leaves woolly on both surfaces with the indumentum ±entirely covering the lamina (cauline leaves sometimes glabrescent or glabrous except on margins) 6

6 Secondary, longitudinal veins conspicuous (leaves usually appearing 3–5-nerved); fibrous leaf bases strongly persistent and numerous on older plants; flowers generally yellow in New South Wales populations and orange in Victorian populations; occurs in lower alpine/subalpine communities ..... ***C. coolaminica***

6: Secondary veins inconspicuous; leaf bases not strongly persistent; flowers generally yellow; confined to high alpine communities in Kosciuszko National Park ..... ***C. maxgrayi***

7 Leaves dark green and ±glabrous (sometimes with sparse hairs), lamina with a conspicuous marginal fringe of white woolly hairs; flowers generally yellow ..... ***C. lamicola***

7: Leaves light green, pubescent, or glabrous, but lamina without a conspicuous marginal fringe of white woolly hairs (margins sometimes slightly woolly in *C. aurantia* but then surfaces scabrous) 8

8 Leaves conspicuously pubescent with long multi-septate hairs terminating in long fine apices; flowers generally yellow but occasionally pale yellow or orange; Kosciuszko National Park endemic ..... ***C. costiniana***

8: Leaves scabrous or ±glabrous 9

9 Leaves long-attenuate at the base, with the base of the leaves distinctly reddish or purplish 10

9: Leaves not long-attenuate at the base or if so then the base of the leaves white or green, rarely with reddish suffusions 11

10 Basal leaves broadly spathulate, the widest 20–40 mm wide, very long-attenuate at the base; in grassy understorey of montane woodland or forest ..... ***C. sp. 1***

10: Basal leaves linear-spathulate to spathulate, the widest to 12 (rarely to 18) mm wide, mostly long-attenuate at the base; subalpine areas, often in grassy plains or open heathlands ..... ***C. crocata***

11 Stereome of capitulum bract narrowly ovate or narrowly oblong, often slightly constricted above the middle; the membranous margins not obviously extending around herbaceous stereome tip, tip greatly exceeding margins and giving the bract a three-lobed appearance; flowers commonly yellow ..... ***C. jamesii***

11: Stereome of capitulum broadly ovate; the membranous margins often extending around herbaceous stereome tip (but if not then stereome tip not greatly exceeding margins); flowers commonly orange ..... ***C. aurantia***

Notes relating to key: Users should note that hybridisation between taxa is common and some specimens with intermediate characters may be difficult to assign. Hybrids are generally commonest in ecotonal sites and/or in areas where the putative parent species occur in close proximity in the same habitat.

Where some indication of habitat is provided, 'alpine' refers to those areas above the treeline, 'subalpine' refers to areas that are below the altitudinal treeline, but treeless (typically in cold air drainage hollows) or lightly wooded usually with Snow-gum (*Eucalyptus pauciflora* Sieber ex Spreng. *sens. lat.*), and 'montane' refers to the zone supporting taller woodland or forest usually dominated by or including tree species other than Snow-gum (e.g. *Eucalyptus dalrympleana* Maiden, *E. delegatensis* R.T. Baker, *E. perriniana* F. Muell. ex Rodway).

Notes on mountain taxa

Craspedia adenophora K.L. McDougall & N.G. Walsh *sp. nov.*

Craspedia sp. B. *sensu* Costin *et al.*, *Kosciuszko Alpine Flora* p. 349 (2000).

Illustration: Costin *et al.* (2000), p. 192.

A Craspedia *speciebus alpinis et subalpinis foliis basalis et bracteis infernis discoloribus, supra glanduloso-viscidis, subter appreso-lanuginosis distinguenda.*

***Type*: VICTORIA.** Mt Stirling, c. 50 m S of summit trig, 15.i.2002, *N.G. Walsh 5516* (holotype: MEL; isotype CANB, NSW)

Tufted or loosely tufted *herbs* c. 10–40 cm high, densely glandular with short microscopic glandular-septate hairs and sessile glands, sticky to the touch. *Leaves* arising from a short erect or ascending rootstock; scape densely glandular, sometimes with appressed silky hairs; stem bracts ±undulate, densely glandular, stem-clasping at base; lower bracts ±discolorous, upper bracts sometimes concolorous, glabrescent, but usually retaining cottony hairs on midrib and margins; leaves mostly basal, obovate-spathulate to oblanceolate-spathulate or narrowly so, 6.5–18 cm long, 8–15(–20) mm wide, discolorous, the adaxial surface dark green, densely glandular, sometimes with variable loosely appressed woolly hairs, particularly on the midrib, densely appressed woolly-tomentose abaxially with short glandular hairs intermixed. *Compound heads* hemispherical to globose at maturity, c. 1.5–3.5 cm diameter; partial heads 5–10 flowered; main bract subtending the lower partial heads with narrowly to broadly ovate to ovate (sometimes obscurely 3-lobed), 6–10 mm long, 2–4.5 mm wide, moderately to densely glandular stereome, ±woolly toward the base, the narrow scarious margins glabrous or ±woolly, rarely extending to the apex of the stereome; corolla yellow (or occasionally pale yellow or orange); achenes c. 1.5–2.5 mm long, antrorsely sericeous; pappus bristles plumose, c. 3.5–5 mm long (Fig. 1).

***Representative specimens*: NEW SOUTH WALES.** south spur of Perisher, 18.i.1970, (NSW); near Seamans Hut, Mt Kosciusko, Jan. 1970, *C. Totterdell 41* (CANB); Top of Main Range on saddle NE of Carruthers Peak, 24.i.2000, *K.L. McDougall 753* (MEL). **VICTORIA.** Snowy Range, 8 km N from Mt Arbuckle, 2.i.1981, *N.G. Walsh 2494* (CANB, MEL, NSW); Mt Buffalo NP, junction of main road between Park Office and Tatra Inn, 26.i.1982, *P.S. Short 1370* (MEL, NSW); The Bluff, 26.i.1985, *D.E. Albrecht 1558* (MEL, NSW); Alpine National Park, Wonnangatta Moroka Unit, c. 1 km NNW from Mt Reynard summit, 14.xii.2000, *N.G. Walsh 5263* (MEL); Mt Buller, beside walking track just below summit cairn, 21.i.2001, *N.G. Walsh 5298* (CANB, MEL); Alpine National Park, access track to Snowy Range airstrip, 22.ii.2001, *N.G. Walsh 5312* (CANB, MEL).

***Distribution and habitat*:** In Kosciuszko National Park, *C. adenophora* is common in the vicinity of Blue Lake, between Carruthers Peak, Mt Twynam and Hedley Tarn, and elsewhere on the Main Range (e.g. Northcote Pass and Mt Townsend). It is locally common in the Victorian high country (e.g. The Bluff, Mt Buller, Mt Buffalo, Mt Stirling, Snowy Plain) but appears to be extremely rare on the Bogong High Plains where we have observed it growing in grassland depressions at the head of Cope Creek.

Throughout its range *C. adenophora* favours dry to damp grasslands and open heaths, and is often found in the vicinity of exposed rock. It has been recorded between 1520 and 2060 metres a.s.l.

***Notes*:** *Craspedia* sp. B was regarded by Everett and Doust (1992), as a hybrid of various species. At that time it was known from a small number of plants in a limited portion of the Kosciuszko Main Range, so a hybrid origin was not an unreasonable suggestion. During field work for the *Kosciuszko Alpine Flora* revision, a more extensive search was made to assess the uniformity and abundance of the entity.

NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2123126
319 ASTERACEAE
Craspedia sp B sens.M.Gray in"Kosciuszko Alpine Flora"2nd ed
Coll.: Walsh, N.G. 5546 Date: 15 Jan 2002
AUSTRALIA : VICTORIA
Region/District: Snowfields
Locality: Mt Stirling, c. 50 m S of summit trig.
Lat.:37°07-36"S Long.:146°29'55"E
Alt.: 1720m Vic. Grid Ref.: 8 G :
Notes: Alpine grassland/open heath. Poa spp., Ranunculus, Grevillea australis, Podolepis robusta, Celmisia pugioniformis common associates.
Tufted perennial herb. Basal leaves greyish beneath, grey-green above; bracts on scape green, viscid, the exudate with a citric odour, Capitula orange, c. hemispherical.
Locally abundant.
Dupls: CANB, NSW
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA

Figure 1. Holotype of *Craspedia adenophora* (MEL 2123126).

At times it was found to be the dominant or sole *Craspedia* in the vegetation and, although some presumed hybrids between it and *C. maxgrayii* J. Everett & Joy Thomps. were found (Max Gray, pers. comm.), *C. adenophora* appeared to be a distinctive and readily identifiable species. Its conservation status is assessed as Rare (*sensu* Briggs & Leigh 1996). An IUCN assessment (IUCN 2001) could place it in any of the categories Near Threatened, Vulnerable or Endangered, depending on the model of climate change that is accepted. As it is not the altitudinally highest occurring *Craspedia* it is probably at lower risk than several of the other species such as *C. costiniana* J.Everett & Joy Thomps., *C. leucantha* F. Muell. or *C. maxgrayi*.

Craspedia adenophora is readily distinguished from other *Craspedia* species in the high country by its discolorous and sticky leaves, which tend to have an odour reminiscent of mouldy oranges or citronella. Flower colour is predominantly bright yellow to pale yellow (rarely orange).

Craspedia species with discolorous leaves may occasionally be found in the high country that are not attributable to *C. adenophora*. For instance, we have observed plants of *C. maxgrayi* to shed hairs on parts of the upper leaf surface in autumn, prior to withering before the onset of snow cover in winter. A presumed hybrid of high mountain summits in Victoria (see notes under *C. maxgrayi*) has leaves of variable hairiness, which may sometimes appear discolorous. Some collections from Mt Buffalo in Victoria (e.g. *J. Russell 106*, MEL 1536817; *N.C. Ford 13*, NSW 297661) have discolorous leaves with very long-attenuate bases and prominent veins. The upper leaf surface of these plants is not glandular (or with a few glandular hairs only towards the leaf tip). These plants are possibly hybrids between *C. coolaminica* J. Everett & Joy Thomps. and *C. adenophora*, both of which have been recorded from Mt Buffalo

Etymology: The epithet (Greek. *aden* = gland, *phora* = bearing) means 'gland-bearing' and refers to the viscid indumentum of the vegetative parts.

Craspedia alba J.Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 223; Costin *et al.* (2000), p. 192; Everett (1999), p. 761.

Plants of this species are generally much smaller than other high country *Craspedia*. They tend to grow in extensive patches in seasonally inundated pools and gravely pavements of short alpine herbfield (Community 10 of McDougall & Walsh 2007). In Victoria, *C. alba* is only known from the Bogong High Plains, where it is extremely localised in Pretty Valley. Although locally common on the Main Range of Kosciuszko National Park in New South Wales in similar habitat, this species is apparently restricted to the area between the Ramshead Range and Mt Twynam. Nationally, the species might be regarded as vulnerable (*sens.* Briggs & Leigh 1996) because of its highly restricted habitat, most commonly at the base of snow packs of the highest mountains. It may be especially affected by decreases in rainfall and snow cover predicted in models of climate change for the Alps (Hennessy *et al.* 2002). It is appropriately regarded as threatened under the Victorian *Flora and Fauna Guarantee Act 1988* given its small population size and extent on the Bogong High Plains.

Craspedia aurantia J.Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 224; Costin *et al.* (2000), p. 192; Everett (1999), p. 761.

New South Wales populations of this species, especially in the alpine zone, may have bright orange or bright yellow flowers. Costin *et al.* (2000) report some overlap of floral characters with *C. jamesii* J. Everett & Joy Thomps. and treat these two species as a complex. We agree that there are difficulties in reliably separating these entities but tentatively retain them here as separate pending a detailed study across the range of the taxa. Victorian populations of *C. aurantia* appear to be much more consistently orange-flowered. The main bract of the involucre may be three-lobed at times but never so pronouncedly as in *C. jamesii*. Everett (1999) indicated that the leaf bases of *C. aurantia* were often conspicuously reddish but these were not observed by us in the field. *Craspedia aurantia* is common and well conserved in grassland and heathland in subalpine and alpine areas of Victoria and New South Wales.

Craspedia coolaminica J.Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 223; Everett (1999), p. 761.

Craspedia coolaminica is widespread in the high country of Victoria and New South Wales, occurring in moister grasslands, heathlands, woodlands and bogs but predominantly (or entirely) below the upper climatic tree line. Unlike plants of this species in New South Wales and the description in Everett (1999), plants in Victoria seem to be consistently orange-flowered. At high altitudes in Victoria, this species may have broad leaves similar in dimensions to *C. maxgrayi*. It is distinguishable from that species by its distinct secondary longitudinal veins and persistent leaf bases. *Craspedia coolaminica* is well represented in conservation reserves in both New South Wales and Victoria and is not considered at risk.

Craspedia costiniana J. Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 224; Costin *et al.* (2000), p. 191.

This distinctive species is endemic to the Main Range of Mt Kosciuszko at altitudes above c. 1900 m (e.g. Rawsons Pass, Mt Townsend, Blue Lake). It is locally common in dense *Poa fawcettiae* Vickery-dominated grassland and less common in other well-drained communities. Flowers are usually bright yellow but pale yellow and orange variants have also been observed. Although this species has a very limited geographic range, it does not appear to be under threat at present.

Craspedia crocata J.Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 224; Everett (1999), p. 761.

In New South Wales, *C. crocata* tends to occur in moist vegetation (grassland, wet heath or bog) of subalpine or montane plains. In Victoria, *C. crocata* has been recorded in the Falls Creek area and some other parts of the Bogong High Plains in grassland, heathland and woodland. With few exceptions, *C. crocata* plants have orange flowers. A distinctive form of this species occurs in species-rich low grassland of a few subalpine plains (e.g. plains west of Mt Jagungal in Kosciuszko National Park, New South Wales, Pretty Valley on the Bogong High Plains, Victoria). The plants of this form grow in colonies amongst prostrate shrubs and dwarf tussocks. Their leaves and capitula are at the low end of the range for the species (typically to c. 5 cm long, c. 1 cm diameter respectively) and the flowers tend to be yellow-orange, at a distance appearing like *Leptorhynchos squamatus* (Labill.) Less. subsp. *alpinus* Flann, with which it grows in such vegetation. The few collections we had of this form did not enable us to find diagnostic characters that separated it from typical *C. crocata*. Further work may allow taxonomic recognition of this form. *Craspedia crocata* is well-protected and abundant throughout its range. The small, colony-forming form, if shown to be a distinct taxon, is rare (especially in Victoria) although not obviously threatened.

Craspedia jamesii J. Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 225; Everett (1999), p. 765.

Craspedia jamesii is found in grassland and grassy woodland of subalpine plains, especially those of lower elevations (e.g. Nungar Plain and Long Plain in New South Wales, Snowy Range and Dinner Plain in Victoria). It can be distinguished from most other high country *Craspedia* by its glabrescent, green leaves and green leaf bases. From *C. aurantia* it differs usually in flower colour (yellow rather than orange) but also in its long, narrow stereome on the main capitula bract, which extends well past the membranous margins. Costin *et al.* (2000) treat this, with *C. aurantia*, as a complex and regard the bract morphology and flower colour as unreliable distinguishing characters. *Craspedia jamesii* is abundant and well conserved across its range.

Craspedia lamicola J.Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 225; Costin *et al.* (2000), p. 192.

Although this species was not included in the *Flora of Victoria* account of *Craspedia* (Everett 1999), plants matching the description occur on the Bogong High Plains in Victoria (e.g. near Mt Cope and Mt Loch, but rare in both these localities). Victorian populations grow in damp vegetation (wet heathland and bog) as the species epithet (meaning 'bog-dweller') suggests. In New South Wales however, this species is more commonly found on dry, rocky ridges (e.g. Mt Etheridge).

Plants of *C. lamicola* are readily distinguished from other *Craspedia* species by their dark green leaves, which are ±glabrous on the lamina but conspicuously white-woolly on the margins. Victorian populations of *C. lamicola* have only been observed to have yellow flowers (although presumed hybrids with *C. aurantia* had somewhat orange flowers).

Craspedia lamicola has apparently become much more abundant in Kosciuszko National Park in the past 30 years (Max Gray, pers. comm.). *Craspedia* species are palatable to cattle (van Rees & Holmes 1986) and are much more common within cattle grazing exclosures established on the Bogong High Plains than outside (Wahren *et al.* 1994). It is possible that the scarcity of *C. lamicola* on the Bogong High Plains is related to past grazing practices. Nationally, the species is rare but not obviously threatened. The known Victoria population however, is very small. A status of vulnerable in Victoria (*sens.* Briggs & Leigh 1996) currently seems appropriate. The recent removal of grazing from the Victorian high country will hopefully facilitate its recovery as appears to have occurred in Kosciuszko National Park.

Craspedia leucantha F.Muell.

Illustration: Everett and Doust (1992), p. 223; Costin *et al.* (2000), p. 194.

This species is easily identified by its white florets and green, sparsely hairy leaves. It is endemic to the alpine zone of the Main Range in Kosciuszko National Park, where it is confined to seepage areas and creek edges. Nationally, the species might be regarded as vulnerable (*sens.* Briggs & Leigh 1996) because of its limited distribution and habitat, which appears to be associated with snow-melt. This habitat is perhaps most at risk from changing climate and its consequent reduced snowfalls. Populations of *Craspedia leucantha* were rarely seen by the authors during a floristic survey of the Main Range in 2003. Further survey is recommended for this species to determine more accurately its distribution and abundance.

Craspedia maxgrayi J.Everett & Joy Thomps.

Illustration: Everett and Doust (1992), p. 223; Costin *et al.* (2000), p. 193; Everett (1999), p. 761.

Craspedia maxgrayi is common on the Main Range of Kosciuszko National Park, where it can be found in grassland and open heath, generally above the tree-line. Outside the Main Range, it appears to occur only on the Mt Bogong plateau in Victoria, where it is rare. Plants with grey, woolly hairs on some leaves or on parts of leaves (especially the midrib) are common in the Mt Nelse–Spion Kopje area in Victoria (less common on Mt Hotham, Mt McKay and Mt Buffalo) and similar plants occur on the slopes of Mt Jagungal in New South Wales. They are perhaps of hybrid origin, the indumentum on their leaves being highly variable. Putative parents for these hybrids are *C. lamicola*, *C. adenophora*, *C. maxgrayi* and *C. coolaminica*. Flower colour may be yellow or orange. Genetic work on this curious and locally common variant may resolve its status. True *Craspedia maxgrayi* appears to have only bright yellow flowers.

Craspedia sp. 1 *sensu* Everett (1999), p. 762

Illustration: Everett (1999), p. 761.

This species is similar in appearance to *C. crocata* but differs in its broad leaves (to 40 mm wide). It occurs in subalpine woodland and montane forest (commonly associated with *Eucalyptus delegatensis*). Currently known from Mt Buffalo, Mt Buller, Mt Hotham, Mt Stirling, The Bluff and Lake Mountain areas. The conservation status of this species is unclear and requires clarification following further survey. It is probably well-protected and abundant over a large area. It is apparently endemic in Victoria.

This species is to be described elsewhere by Joy Everett (National Herbarium of New South Wales) who first realised its distinctness.

Acknowledgements

We are grateful to Max Gray (ex-CSIRO) for his encouragement when the taxonomy of the mountain *Craspedia* seemed too daunting, and for having the perspicacity to recognise most of the taxa in the 1979 edition of the Kosciuszko Alpine Flora.

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Two new *Pomaderris* (Rhamnaceae) from south-eastern Australia

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Abstract

Two new species of *Pomaderris* (Rhamnaceae: Pomaderrae) are described from south-eastern Australia. *Pomaderris buchanensis* N.G.Walsh appears to be confined to scrubs inhabiting rocky banks of the Snowy River in the vicinity of Buchan. It appears to be most closely related to *Pomaderris aspera* D.C. and *P. oblongifollia* N.G.Walsh. *Pomaderris viridis* N.G.Walsh is a narrow-range endemic of south-eastern New South Wales, occurring in moist forests, sometimes along watercourses. Its nearest congeners appear to be *P. aspera* and *P. cinerea* Benth. Both of the new species are considered to be rare.

Muelleria 26(2): 11-16 (2008)

Introduction

Pomaderris, with c. 70 species, is the largest genus of the Rhamnaceae in Australia. It is largely confined to this country, with 8 species (3 or 4 endemic) also occurring in New Zealand. Preparation of accounts for state floras and on-going work on a complete revision of the genus for the *Flora of Australia* (Thiele *et al.* in prep.) has resulted in a number of publications seeking to resolve the numerous taxonomic problems and to elucidate the relationships within the genus (e.g. Millot & McDougall 2005; Ross 1990; Walsh 1988, 1989, 1990a, 1990b, 1992, 1994, 1999; Walsh & Coates 1997). Subsequent scrutiny of specimens not properly accounted for in these works, and subsequent fieldwork has led to the conclusion that some of these can be accounted for by erecting 2 new species. They are here described.

Pomaderris buchanensis N.G.Walsh, *sp. nov.*

Species affinis P. oblongifoliae *N.G.Walsh et* P. asperae *DC., a primo foliis majoribus, serratis, indumento crassioribus differt, a secundo foliis minoribus, indumento tenuiore, subter foliis densiore, inflorescentia paucifloribus compositis differt.*

***Type*: VICTORIA**. Snowy River, c. 500 m upstream of confluence with Buchan River, 2.xii.2003, *N.G.Walsh 5921* (holotype: MEL 2212498; isotype: CANB, NSW).

Shrub to c. 4 m high. Young *stems* densely covered with fine, rusty stellate hairs (c. 0.1–0.2 mm across). *Leaves* narrowly ovate or lanceolate, rarely narrow-elliptic, (35–)50–80 mm long, 10–23 mm wide; base obtuse; margins irregularly serrate, or shallowly sinuate, or entire, flat or very weakly recurved; apex obtuse or rarely acute; adaxial lamina with scattered stellate hairs, rarely quite glabrous or moderately densely hispid; primary lateral veins usually strongly impressed, secondary veins obscure; abaxial lamina entirely covered with dense stellate hairs, rusty at first, but whitening with age; midrib and lateral veins prominent; petiole 4–8 mm long. *Stipules* linear, 2–3.5 mm long, caducous. *Inflorescences* of loose, slender, terminal and upper-axillary panicles to c. 10 cm long, comprising numerous nearly umbellate cymes, each of c. 4–10 flowers; bracts linear, 1–2.4 mm long, caducous;

NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2212498
234 RHAMNACEAE
Pomaderris sp.
Coll.: Walsh, N.G. 5921 Date: 02 Dec 2003
AUSTRALIA : VICTORIA
Region/District: East Gippsland
Locality: Snowy River, west bank, c. 500 m upstream of confluence with Buchan River.
Lat.:37°30'43"S Long.:148°16'44"E
Alt.: 70m Vic. Grid Ref.: W 35:
Notes: Scrub with Acacia mearnsii, A. boormanii, Tristaniopsis laurina, Calytrix tetragona, Kunzea ericoides sens. lat., Bursaria spinosa. Shallow sandy soil derived from Snowy River volcanics.
Shrubs c. 4 m high. Flowers pale yellow-green.
About 8 plants from juvenile to adult
Dupls: CANB, NSW
HOLOTYPE
NATIONAL HERBARIUM OF VICTORIA (MEL)
Pomaderris buchanensis N.G.Walsh
Determinavit N.G.Walsh 18·vii·2006
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA

Figure 1. *Pomaderris buchanensis* holotype (MEL 2212498)

pedicels 1.5–3 mm long at anthesis, elongating to c. 5 mm long in fruit. *Flowers* pale greenish or yellowish, often mottled crimson; externally densely covered with fine rusty stellate hairs; hypanthium c. 1.2 mm diam., 1.5 mm long at anthesis; sepals 1.2–1.5 mm long, persisting on ripening fruits; petals absent; stamens 1–1.5 mm long; anthers c. 0.5 mm long; ovary inferior, summit covered with fine stellate hairs; style glabrous, 0.7–1.3 mm long, 3-branched from near midway. *Fruit* a 3-partite schizocarp, c. 2.5 mm long, obovoid, dark brown, apex obtuse, sometimes shortly apiculate; torus in the upper third; operculum ±half to two-thirds length of fruitlet; seed c. 2 mm long (only 1 sparsely fruiting specimen seen). Flowers November and December (3 records). Fig. 1.

Representative specimens (7 specimens examined): **VICTORIA.** Musk Creek – Snowy River junction, 18.ix.1979, *S.J. Forbes 324* (MEL); Snowy River c. 0.6 km upstream of Snowy – Buchan River confluence, 27.xi.1990, *N.G. Walsh 3018* (MEL); Snowy River c. 3 km upstream of Snowy – Buchan River confluence, 27.xi.1990, *N.G. Walsh 3014* (MEL); Snowy River at Long Point, 2.viii.2002, *N.G. Walsh 5576* (MEL).

Distribution and Conservation Status: Collected from banks of the Snowy River between Tuloch Ard Gorge (c. 20 km NE of Buchan) and at least as far downstream as Long Point (c. 20 km SE from Buchan). All populations of *P. buchanensis* are reserved within the Snowy River National Park. Its Risk Code is assessed to be rare (2Rc, *sensu* Briggs & Leigh 1996), or vulnerable (VU Ca9i0; D1+2) sensu IUCN (2001), based on the small total population size (estimated at less than 1000 plants) and geographic restriction (area of occupancy less than 20 km^2).

Habitat: Locally common on rocky banks of the river at about present-day flood-level, sometimes forming pure stands of 50 or more plants. Associated species include *Acacia boormanii* Maiden, *A. dealbata* Link, *Bursaria spinosa* Cav., *Calytrix tetragona* Labill., *Dodonaea rhombifolia* N.A.Wakef., *D. viscosa* Jacq., *Leptospermum brevipes* F. Muell., *Pomaderris aspera*.

Notes: Initially believed to be a hybrid involving *P. aspera* and *P. oblongifolia* and referred to as such in Walsh (1999, p. 96), the former a widespread species in south-eastern Australia, the latter a localised endemic

Table 1. Comparison of a range of measurements for *Pomaderris* species mentioned in text.

	P. aspera	*P. oblongifolia*	*P. buchanensis*	*P. cinerea*	*P. viridis*
Leaf length (mm)	40–120	20–60	35–80	15–60	20–55
Leaf width (mm)	20–60	6–15	10–23	7–28	15–30
Leaf margin	serrulate	entire	irregularly serrate to shallowly sinuate	entire	irregularly serrate
Leaf indumentum density adaxial lamina	glabrous to sparse	glabrous to dense	sparse, rarely glabrous	very dense	sparse to moderately dense
Leaf indumentum density abaxial lamina	dense to moderately dense, rarely sparse	very dense	very dense	very dense	sparse to moderately dense
Trichome diameter abaxial lamina (mm)	0.4–0.6	0.2–0.4	0.4–0.5	0.1–0.2	0.3–0.5
Sepals persistence	persistent	persistent	persistent	deciduous	deciduous
Hypanthium length (mm)	0.5–1	1–1.2	c. 1.5	0.5–0.8	0.3–0.5
Sepal length (mm)	1.5–2	1.2–1.7	1.2–1.5	1.2–1.8	1.2–1.5
Inflorescence length (mm)	5–35	1–5	1–10	2–6	5–8

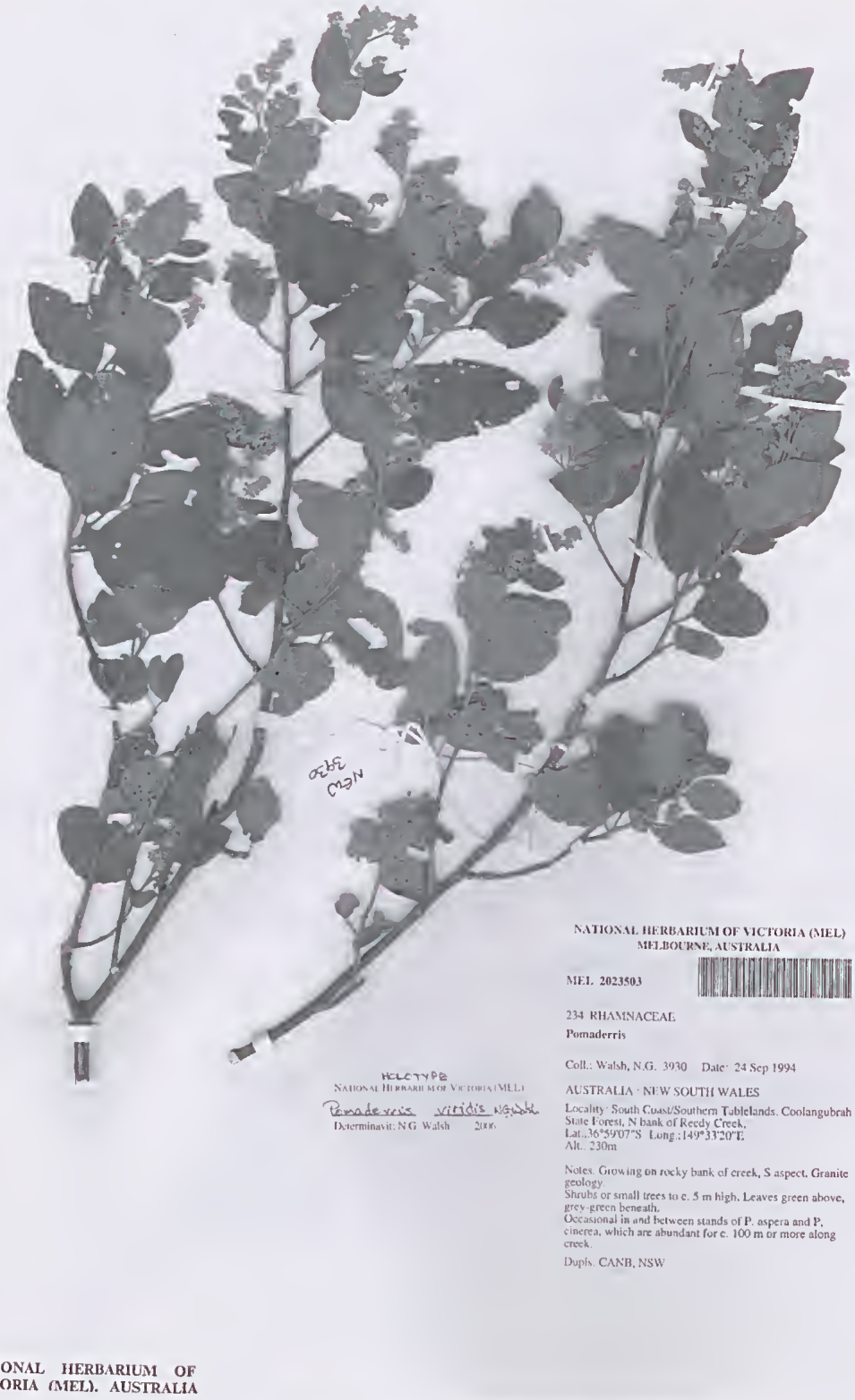
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2023503
234 RHAMNACEAE
Pomaderris
Coll.: Walsh, N.G. 3930 Date: 24 Sep 1994
AUSTRALIA - NEW SOUTH WALES
Locality: South Coast/Southern Tablelands. Coolangubrah State Forest, N bank of Reedy Creek.
Lat.:36°59'07"S Long.:149°33'20"E
Alt.: 230m
Notes. Growing on rocky bank of creek, S aspect. Granite geology.
Shrubs or small trees to c. 5 m high. Leaves green above, grey-green beneath.
Occasional in and between stands of P. aspera and P. cinerea, which are abundant for c. 100 m or more along creek.
Dupls. CANB, NSW
HOLOTYPE
NATIONAL HERBARIUM OF VICTORIA (MEL)
Pomaderris viridis N.G.Walsh
Determinavit: N.G. Walsh 2006
NATIONAL HERBARIUM OF VICTORIA (MEL). AUSTRALIA

Figure 2. *Pomaderris viridis* holotype (MEL 2023503)

of the Snowy and Little Rivers. Although confined to the same catchment as *P. oblongifolia* it is rarely found in very close proximity to it and is known to occur at least 30 km distant from the nearest occurrence of that species. The entirely stellate indumentum, persistent sepals and linear stipules and bracts place it in section *Apetalae* (Walsh & Coates 1997) to which both *P. aspera* and *P. oblongifolia* are referred. It differs most obviously from *P. aspera* in the smaller leaves with finer, denser indumentum on the lower surfaces of the leaves, and the fewer-flowered inflorescences. From *P. oblongifolia* it differs in having larger leaves that are somewhat serrate and a coarser indumentum (Table 1).

Given the intermediacy of characters between those two species, it seems likely that it is of hybrid origin, but the consistency of form and largely allopatric (with respect to *P. oblongifolia*) distribution strongly suggest that it has evolved to be a true-breeding species.

Etymology: The epithet refers to the known occurrence of the species, in the vicinity of the township of Buchan.

Pomaderris viridis N.G.Walsh, *sp. nov.*

Fortasse hybrida characteribus inter P. asperam *DC. et* P. cineream *Benth. A primo foliis minoribus tenuioribus et sepalis deciduis differt, a secundo indumento multo sparsiore et foliis leniter serratis differt.*

Type: **NEW SOUTH WALES**. Coolangubrah State Forest, N bank of Reedy Creek, 24.ix.1994, *N.G. Walsh 3930* (holotype: MEL; isotype: CANB, NSW)

Pomaderris sp. C *sensu* G. Harden, *Fl. New South Wales* 1: 365 (1990); Jacobs & Pickard (1981).

Shrub or *small tree* 2–5 m high. Young *stems* densely covered with pale stellate hairs (c. 0.2–0.4 mm across). *Leaves* ovate to elliptic, (20–)25–45(–55) mm long, (15–)18–25(–30) mm wide; rather thin-textured; base obtuse; margins irregularly serrate or crenate, or rarely, quite entire, flat or margins very weakly recurved; apex obtuse; adaxial lamina evenly covered with stellate hairs but the lamina remaining visible beneath the indumentum; primary lateral veins weakly impressed, secondary veins not developed, the internerve space occupied by a regular fine reticulum; abaxial lamina lightly covered with pale stellate hairs, the lamina quite apparent beneath; petiole 4–9 mm long. *Stipules* very narrowly triangular or linear, 3–5 mm long, caducous. *Inflorescences* of slender, terminal and upper-axillary panicles mostly 5–8 cm long, composed of numerous umbellate cymes, each of c. 4–10 flowers; bracts ovate to narrowly triangular, 1–2 mm long, deciduous; pedicels 1.5–3 mm long. *Flowers* cream to pale yellowish-green; externally densely covered with fine grey stellate hairs; hypanthium 0.8–1 mm diam., 0.3–0.5 mm long at anthesis; sepals 1.2–1.5 mm long, deciduous; petals absent; stamens c. 1 mm long; anthers c. 0.7 mm long; ovary ±half-inferior, summit covered with fine stellate hairs and sometimes a few longer simple hairs; style glabrous, 0.7–1 mm long, 3-branched from midway or nearer base. *Fruit* a 3-partite schizocarp, 2.7–3 mm long, obovoid to ellipsoid, dark brown, apex obtuse, shortly apiculate; torus in lower third or quarter; operculum not developed, or very small at base of inner face of fruitlet; seed released by medial split of ventral face of fruitlet, 1.5–1.7 mm long. Flowers November (2 records). Fig. 2.

Representative specimens (11 specimens examined): **NEW SOUTH WALES.** Reedy Creek, Coolangubra State Forest, 1.ix.1983, *A. Nunnink 575* (MEL, NSW); Reedy Ck, Coolangubra State Forest, 15.xi.1984, *R. Shiels 448 & R.M. Allen* (MEL, NSW); Wadbilliga National Park, Yankees Creek, 19.iv.1992, *I. Crawford 1758* (CANB, MEL, NSW); Brogo, c. 100 m above Brogo River, 12.x.1995, *N.G. Walsh 4042* (MEL); Upper Cobargo Rd, 12 km NNW of Bega, 5.ii.1996, *J. Miles* s.n. (MEL).

Distribution and Conservation Status: Known from a few localities in south-eastern New South Wales, in an area approximately bounded by the settlements of Bemboka, Brogo and Towamba. Specimens and field observations indicate that plants may occur singly or abundantly in thickets. *Pomaderris viridis* is reserved within Wadbilliga National Park. Its conservation status is tentatively assessed as rare (2Rc, *sensu* Briggs & Leigh 1996) or vulnerable (VU Ca9i0; D1+2) sensu IUCN (2001).

Habitat: Commonly occurs in rocky sites, usually in the vicinity of watercourses, but also collected from moist forest on mid-slopes of low ridgelines. Soils are loamy, mainly derived from sedimentary parent material. Typically associated species include *Acacia floribunda* (Vent.) Willd., *A. silvestris* Tindale, *Angophora floribunda* (Sm.) Sweet, *Beyeria lasiocarpa* Muell. Arg., *Eucalyptus elata* Dehnh., *E. globoidea* Blakely, *E. maidenii* F.Muell., *E. smithii* R.T.Baker, *E. viminalis* Labill., *Philotheca trachyphylla* (F.Muell.) Paul G.Wilson, *Pomaderris brogoensis* N.G.Walsh, *P. cinerea*, *P. aspera*.

Notes: Most collections of *P. viridis* indicate association with *P. aspera* and *P. cinerea*, and it is believed to be likely that it is either an F1 hybrid with these two species as parents, or it is a true-breeding species of hybrid ancestry. *Pomaderris aspera* is a common and widespread species in south-eastern Australia whereas *P. cinerea* is a species of limited distribution in south-eastern New South Wales – its distribution fully encompassing that of *P. viridis*. *Pomaderris viridis* differs from *P. aspera* in its smaller, thinner-textured leaves and in its deciduous sepals. From *P. cinerea* it differs in having a much sparser indumentum and leaves that are usually slightly serrate (Table 1).

At the Reedy Creek, Coolangubra State Forest site (e.g. Nunnink 575), *P. viridis* occurs as a dense stand between and contiguous with stands of *P. aspera* and *P. cinerea*. The plants in this population are morphologically uniform and the characters of indumentum, leaf size and shape are quite intermediate between those two species. Limited growth trials at the Royal Botanic Gardens, Melbourne have shown that the seed of *P. viridis* is viable, and appears to breed true with no apparent segregation of seedlings toward either putative parent species suggesting that, if of hybrid ancestry, it is now 'stabilised' and a true-breeding species. However these observations must be regarded as preliminary as they are based on observations of only 5 plants that failed to develop to maturity. It is because *P. viridis* is known from a number of sites and is morphologically distinct and uniform that it is being formally described here. Amongst the many thousands of specimens of *Pomaderris* in Australian herbaria that have been examined in the course of preparing an account of the genus, a few have been tentatively identified as hybrids between a number of good species (e.g. *P. lanigera* (Andrews) Sims x *P. intermedia* Sieber ex. DC., *P. aspera* x *P. oraria* F. Muell. ex Reissek subsp. *calcicola* N.G.Walsh), but *P. viridis* occurs with a frequency and morphological consistency that sets it apart from this disparate group. If it is a hybrid, it is the only hybrid known so far between members of different sections (*P. aspera* is a member of section *Apetalae* while *P. cinerea* is a member of section *Pomaderris*; Walsh & Coates 1997). Further research is encouraged to verify the status of *P. viridis* as a hybrid or a true-breeding species.

Etymology: The epithet (Latin: *viridis* = green) refers to the general aspect of the plant. The leaves of this species are less strongly discolorous than they are in most species of *Pomaderris* and the indumentum is relatively sparse, exposing the green epidermis of both upper and lower surfaces.

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A new species of *Poa* (Poaceae) from the Victorian Basalt Plain

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ca 241621

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Introduction

In the course of recent surveys of saline lakes of the Victorian Volcanic Plain (Conn 1993), several populations of an unknown *Poa* of uniform anatomy and similar habitat were discovered. Consultation with a draft treatment of the genus for the forthcoming volume 44 of the *Flora of Australia* (Weiller & Walsh in ed.) and with specimens at the National Herbarium of Victoria (MEL) has led to the conclusion that these populations represent a new, previously uncollected species. The opportunity is taken here to describe this new species in the hope that it may be included in the *Flora of Australia* account.

Taxonomy

Poa physoclina **N.G.Walsh** *sp. nov.*

A P. labillardierei *Steud. laminis involutis, non-scabrosis, a* P. sieberiana *Spreng. lemmatis glabris dorsaliter praeter costam et araneam, et ab ambabus paniculis diffusis et culmis infirmis cadentibus differt.*

Type: **VICTORIA**. Lake Bolac township, opposite Lake Paracemalac, E side of Lake Bolac – Ararat Rd, 1.3 km N from Glenelg Hwy, *N.G. Walsh 6781* (holotype: MEL; isotype: CANB, K, NSW).

Slender caespitose *perennial*. *Leaves* basal. *Culms* 15–40 cm high, but readily laying flat after anthesis, terete or slightly elliptic in section, antrorsely to retrorsely minutely pubescent, nodes usually absent above basal sheaths. Young shoots intravaginal. *Basal leaf sheaths* not pigmented or, rarely, somewhat reddish, glabrous or with scattered, microscopic hairs. *Sheaths* of culm-leaves often with denser, slightly longer hairs; margins free. *Ligule* membranous, c. 0.3 mm long, truncate, abaxially minutely and sparsely hairy. *Leaf blades* green, not glaucous, conduplicate, biconvex to nearly terete, 10–20(–25) cm, long, 0.2–0.4 mm wide, indistinctly nerved, abaxially glabrous or more commonly with minute (<0.1 mm long), scattered to mid-dense, antrorsely inclined hairs, adaxially minutely densely pilose; tip tapered to a point, but not pungent. *Inflorescence* broad and diffuse, 5–12 cm long, 5–10 cm wide, branches from lowest nodes usually naked and unbranched in the proximal half. *Spikelets* mostly 2-flowered, rarely to 4-flowered

Abstract

A new species of *Poa*, *P. physoclina* N.G. Walsh, apparently confined to halophytic vegetation near the margins of salt lakes on the Victorian Volcanic Plain is described and illustrated. The known range of the species is c. 70 km (between Lake Bolac and Camperdown). Its ecology and conservation status are discussed. Taxonomic relationships with other native *Poa* species are unclear, but floral anatomy suggests that it is most closely related to the widespread and variable *P. labillardierei* Steud. The new species is remarkable for its diffuse, weak-culmed flowering panicle.

Muelleria 26(2): 17-20 (2008)

Royal Botanic Gardens Melbourne

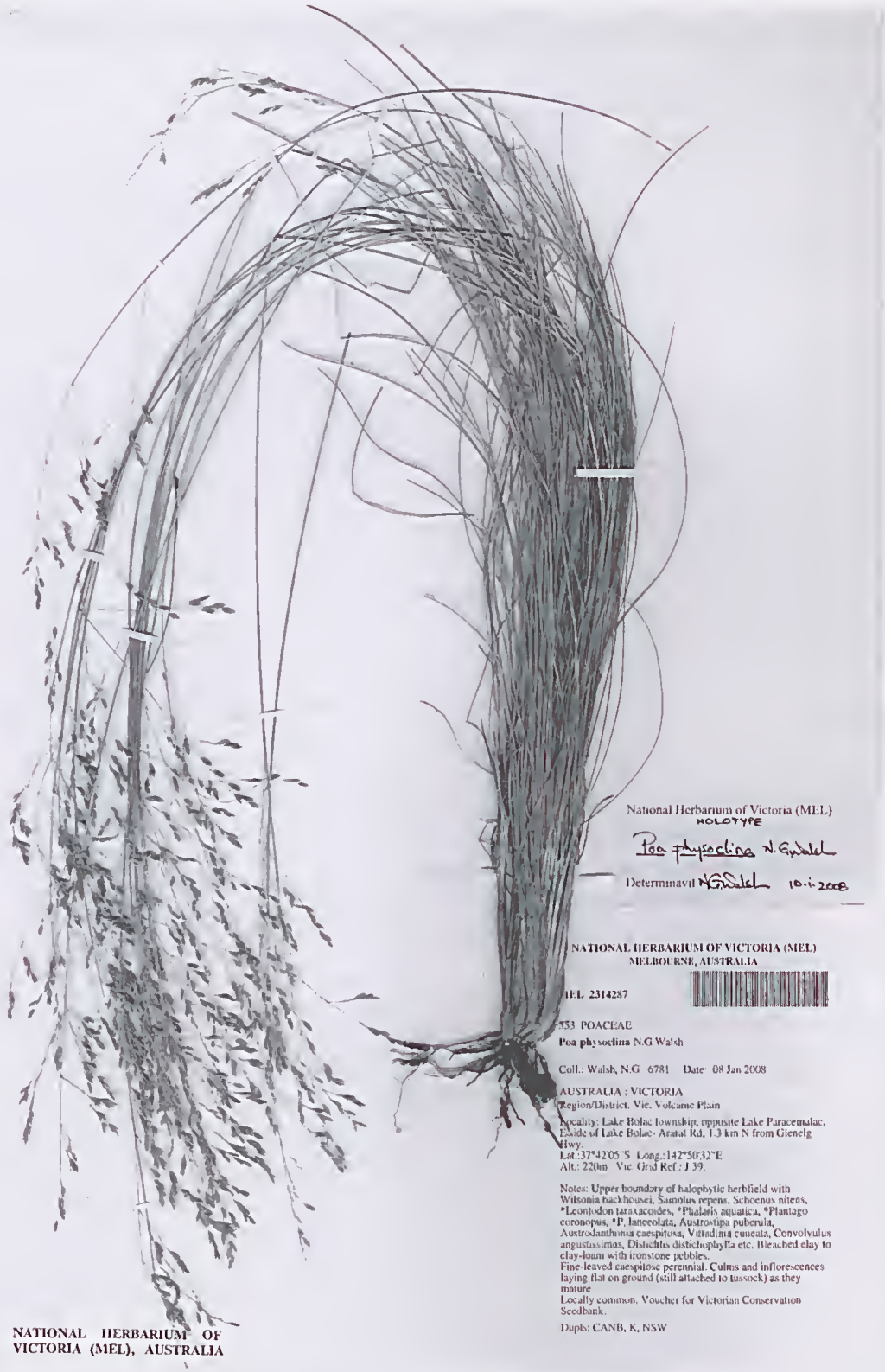
National Herbarium of Victoria (MEL)
HOLOTYPE
Poa physoclina N.G.Walsh
Determinavit N.G.Walsh 10.i.2008
NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA
MEL 2314287
733 POACEAE
Poa physoclina N.G.Walsh
Coll.: Walsh, N.G 6781 Date: 08 Jan 2008
AUSTRALIA : VICTORIA
Region/District. Vic. Volcanic Plain
Locality: Lake Bolac township, opposite Lake Paracombac, E side of Lake Bolac- Ararat Rd, 1.3 km N from Glenelg Hwy.
Lat.:37°42'05"S Long.:142°50'32"E
Alt.: 220m Vic. Grid Ref.: J 39.
Notes: Upper boundary of halophytic herbfield with Wilsonia backhousei, Samolus repens, Schoenus nitens, *Leontodon taraxacoides, *Phalaris aquatica, *Plantago coronopus, *P. lanceolata, Austrostipa puberula, Austrodanthonia caespitosa, Vittadinia cuneata, Convolvulus angustissimus, Distichlis distichophylla etc. Bleached clay to clay-loam with ironstone pebbles.
Fine-leaved caespitose perennial. Culms and inflorescences laying flat on ground (still attached to tussock) as they mature
Locally common. Voucher for Victorian Conservation Seedbank.
Dupls: CANB, K, NSW
NATIONAL HERBARIUM OF VICTORIA (MEL), AUSTRALIA

Figure 1. Holotype of *Poa physoclina* (MEL 2314287)

and then the terminal floret often sterile, 3.5–5(–6.5) mm long, green or tinged purple at anthesis, entirely stramineous or paler when seed matures. *Glumes* subequal, 2–3.5 mm long, the upper slightly longer than the lower, ¾ of the length of the proximal lemma, acute, keel scaberulous, intercostal regions scaberulous to scabrous; lower glume 2.2–3.1 mm long, 3-nerved; upper glume 2.5–3.5 mm long, 3-nerved. Lowest *lemma* 3.0–4.1 mm long, broadly acute in profile, 5-nerved, the midrib minutely scaberulous toward apex, covered in the lower ½– by fine white hairs; intercostal regions and flanks glabrous, minutely granular; web present, rather sparse, to 1.5 mm long. *Callus* usually with a few scattered hairs. *Palea* slightly shorter than its lemma, shortly scabrid-ciliate along the keels. *Anthers* 1.5–2 mm long. Fig. 1, 2.

Distribution and habitat: *Poa physoclina* is apparently endemic to the fringes of salt lakes of the Victorian Volcanic Plain (Conn 1993). It is currently known from the margins of 5 lakes or seasonal wetlands in separate drainage systems in an area bounded by Camperdown, Skipton and Lake Bolac township environs. It occurs in a narrow altitudinal band between c. 0.2 and 1.0 m above high water level, but this band may be relatively broad (e.g. to 30 m at Lake Burnie Bolac) and the grass dominant in this area (Fig. 3). Adjacent to the *Poa physoclina* zone toward the lake margin is typically a low halophytic shrubland or herbfied dominated by *Samolus repens* (J.R.Forst. & G.Forst.) Pers., *Sarcocornia quinqueflora* (Bunge ex Ung.-Sternb.) A.J.Scott and *Selliera radicans* Cav., while on the higher, less saline ground is often a grassland dominated by *Austrostipa* spp. and *Austrodanthonia* spp. Species that are commonly associated with *Poa physoclina* include *Distichlis distichophylla* (Labill.) Fassett, *Plantago coronopus* L. (exotic), *Samolus repens*, *Schoenus nitens* (R.Br.) Poir. ex Roem. & Schult. and *Wilsonia backhousei* Hook.f. Soils are saline black cracking clays (black vertosols *sensu* Isbell 1996) or clay-loams, sometimes bleached and sometimes incorporating ironstone pebbles.

Figure 2. Spikelet and floret of *Poa physoclina* from holotype (scale 0.5 mm divisions)

Conservation Status: The grass occurs in conservation reserves at two of the five known sites – the Parupa Lakes Reserve at Lake Bolac, and at Lake Burnie Bolac Wildlife Reserve near Darlington. The remaining sites are on private property. At each of these sites it is locally common and dominant in its restricted ecological range. It is probably premature to provide a credible conservation status, but on current knowledge, it should be regarded as Endangered (EN *sensu* IUCN 2001), or Vulnerable (2Va *sensu* Briggs & Leigh 1996). The major threat is probably encroachment by the widespread exotic grasses *Phalaris aquatica* L. and *Lophypyrum ponticum* (Podp.) A.Love which form extensive swards nearby and show a capacity to tolerate salinity levels near to, if not beyond, those that typify the habitat of *Poa physoclina*.

Etymology: The epithet *physoclina* (Greek *physa* - wind; *klienein* - to lie down) refers to the distinctive trait of the weak culms being blown flat by wind even before the seeds have matured.

Notes: Distinctive features of *Poa physoclina* are the very fine foliage, the weak culms that lack nodes from shortly above the base, the sparse inflorescences, the few-flowered spikelets and the lemmas that are glabrous other than the line of hairs on the midrib, and the presence of a distinct web. Vegetatively it perhaps most resembles fine-leaved forms of *Poa sieberiana*, but the relatively narrower and webbed florets distinguish it from that species. From *P. labillardierei*, which is common on the Victorian Volcanic Plain in less saline habitats, it is distinguished in the narrower, conduplicate, biconvex to terete and non-scabrous leaf blades and the generally smaller, fewer-flowered spikelets. From both of these

Figure 3. *Poo physoclino* in situ, Lake Burnie Bolac. Photo A.M. Pritchard

species it is readily distinguished by the weak culms that are readily laid flat by even gentle winds. (Fig. 3).

It is remarkable that such a distinctive grass had remained unrepresented in the collections at MEL until 2003.

***Specimens examined*: VICTORIA.** 'Koorawerra', Kariah via Camperdown, Dec. 2003, *K. Dickson s.n.* (MEL); Lake Burnie Bolac, 3.xii.2007, *A. Pritchord s.n.* (MEL); Crossroads, on the Eurambeen-Streatham Rd, 6.xii.2007, *A.J. Brown 1801* (HO, MEL, NSW); Skipton, 3.5 km SE of town, 6.xii.2007, *A.J. Brown 1800* (CANB, MEL); Lake Paracemalac, 15.xii.2007, *R. Thompson s.n.* (MEL).

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New *Lachnagrostis* (Poaceae) taxa from South Australia and South-west Victoria

a241622

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Introduction

Lachnagrostis Trin. has only recently been accepted in Australia (Jacobs 2001, 2002, 2004); species in it having formerly been included in *Agrostis* L. The majority of *Lachnagrostis* species grow in lowland habitats, in contrast to the largely montane habitats of endemic species of *Agrostis* (an exception being the widespread *A. venusta* Trin.).

Two species, *L. aemula* (R.Br.) Trin. and *L. filiformis* (G.Forst.) Trin. extend from lowland to upland environments but even across their lowland habitats, show a wide range of morphological forms (Walsh & Entwistle 1994). To more closely investigate these forms, extensive collection and examination of lowland populations of *Lachnagrostis* in south-east Australia was undertaken across south-west Victoria and South Australia from the early 1990s through to the present. Work with *L. billardierei* (R.Br.) S.W.L.Jacobs, *L. punicea* (A.J.Br. & N.G.Walsh) S.W.L.Jacobs and *L. robusta* (Vickery) S.W.L.Jacobs established new combinations (Brown & Walsh 2000) and relationships among some of these taxa and with *L. aemula* and *L. filiformis* (James & Brown 2000; James *et al.* 2002).

While work examining the variation within *L. filiformis* and *L. aemula* continues, a number of populations with characteristics substantially different from existing taxa, have been separated out for further study and reporting here. Specimens from Victoria having spikelet glume apices with long setae and inflorescences with prominently deflexed branches are here segregated as *L. deflexa* while plants with similar spikelets but with congested and somewhat contracted panicles and sterile florets are here designated *L.* ×*contracta*. Specimens from the Mount Lofty Ranges with very fine inflorescences and small spikelets with almost glabrous lemmas and short, straight awns are named *L. batesii*, while taller plants from similar environments with hairy lemmas, small spikelets and wide leaves are described here as *L. perennis*. Plants with strongly purple inflorescences, spikelets similar to *L. aemula* but with narrow leaves, from the border country between South Australia and Victoria, are here segregated as *L. palustris*. Finally, plants from a restricted area to the west of the southern Grampians in Victoria and similar to *L. aemula*, but with more or less awnless lemmas and narrow leaves are designated as *L. leviseta*.

Abstract

Unusual and indeterminate populations of *Lachnagrostis* Trin. were examined, both as herbarium specimens and in the field. Some of these entities were also studied as potted plants grown from field collected seed to determine if morphological departures from currently circumscribed taxa were the result of environmental change or could be concluded to be genetically based. Although vegetative growth (particularly leaf width) was markedly increased by artificial growth conditions, morphological characteristics of inflorescences, spikelets and florets were largely unaltered. As a result of these studies, this paper describes four new species; *L. batesii* A.J.Br. from South Australia, *L. deflexa* A.J.Br. and *L. leviseta* A.J.Br. from Victoria and *L. palustris* A.J.Br. from the border region of the two States. The status of *Agrostis avenacea* var. *perennis* Vickery is raised to species level, *L. perennis* (Vickery) A.J.Br. but restricts its distribution to the Mount Lofty Ranges of South Australia. In addition, an apparently sterile interspecific hybrid *L.* ×*contracta* A.J.Br., probably *L. deflexa* × *L. adamsonii* (Vickery) S.W.L.Jacobs, from Victoria is reported.

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Table 1. Field collections of *Lachnagrostis* taxa selected for spikelet morphology comparison (* new taxa).

Species	Selection	Voucher specimen collection details
L. odomsonii	Caramut, Vic.	7.xii.1995, *Brown* 1013 (MEL)
	Dereel, Vic.	15.xii.1995, *Brown* 1056 (NSW, MEL)
	Moorabool, Vic.	18.xii.1995, *Brown* 1075 (MEL)
	Barunah, Vic.	21.xii.1995, *Brown* 1113 (MEL)
***L. aemula* A**	Scott Creek, SA	i.2001, *Botes* 5802S (MEL)
	Mt. Bold, SA	i.2006, *Botes* 67484 (MEL)
	Prospect Hill, SA	10.xii.2003, *Botes* 61922 (MEL)
	Mt. Remarkable, SA	27.xi.2003, *Botes* 61834 (MEL)
***L. aemula* B**	Lake Mundi, Vic.	31.xii.2003, *Brown* 1766 (AD, MEL)
	Nangwarry South, SA	31.xii.2003, *Brown* 1769 (AD, MEL)
	Arapiles, Vic.	8.xii.2005, *Brown* 17S8 (MEL)
	Balmoral, Vic.	22.xii.2003, *Brown* 1770 (MEL)
L. botesii*	Scott Creek, SA	30.i.2001, *Botes* 58030 (MEL)
	Aldgate Valley, SA	i.2001, *Botes* 58038 (MEL)
	Scott Bottom, SA	29.xii.2003, *Brown* 1638 (NSW, MEL, HO)
	Jupiter Creek, SA	i.2006, *Botes* 67482 (MEL)
L. ×controcto*	Streatham, Vic.	11.i.1994, *Brown* 877 (AD, MEL)
	Skipton, Vic.	16.xii.1996, *Brown* 1222 (AD, CANB, MEL)
	Derrinallum, Vic.	21.xii.2005, *Brown* 1721 (NSW, MEL, HO)
L. deflexo*	Streatham, Vic.	11.i.1994, *Brown* 871 (AD, NSW, CANB, MEL, HO)
	Mininera East, Vic.	11.i.1994, *Brown* 875 (NSW, CANB, MEL, HO)
	Lake Bolac, Vic.	31.xii.2003, *Brown* 1718 (NSW, CANB, MEL)
	Deep Lake, Vic.	18.i.2006, *Brown* 1723 (NSW, MEL)
***L. filiformis* A**	Connewarren, Vic.	5.i.1996, *Brown* 1119 (MEL)
	Nangwarry, SA	31.xii.2003, *Brown* 1771 (AD, NSW, MEL)
	Glenisla Crossing, Vic.	7.xii.2005, *Brown* 1772 (MEL)
	Dorodong, Vic.	18.i.2006, *Brown* 1773 (AD, MEL)
***L. filiformis* B**	Beaumont, SA	1.xii.1946, *Clelond* s.n. (AD97222056)
	Penola, SA	16.xi.1969, *Wilson* 1284 (AD)
	Tallangatta, Vic.	29.xi.2006, *Brown* 1764 (AD, MEL)
	Shepparton East, Vic.	30.xi.2006, *Brown* 1765 (AD, MEL)
L. leviseto*	Gatum, Vic.	22.xii.2003, *Brown* 164S (MEL)
	Glendinning, Vic.	31.xii.2004, *Brown* 1713 (MEL, HO)
	Moorella, Vic.	6.xii.2005, *Brown* 1714 (CANB, MEL)
	Victoria Valley, Vic.	6.xii.2005, *Brown* 171S (AD, NSW, MEL)
L. palustris*	Nangwarry, SA	15.i.2001, *Botes* 58010 (AD, MEL)
	Nangwarry South, SA	31.xii.2003, *Brown* 1643 (AD, MEL, HO)
	Heathfield, Vic.	31.xii.2003, *Brown* 1644 (AD, MEL)
	Topperwein, SA	17.i.2006, *Brown* 1709 (MEL)
L. perennis*	Mount Adam, SA	27.xii.2000, *Botes* 57934 (AD, MEL)
	Hindmarsh Valley, SA	29.i.2001, *Botes* 58026 (MEL)
	Little Para River, SA	30.xii.2003, *Brown* 1640 (NSW, CANB, MEL)
	Hansborough, SA	30.xii.2003, *Brown* 1724 (NSW, MEL, HO)

This paper provides the results of morphological assessment of these new taxa in comparison with currently well established species.

Materials and Methods

Spikelet Morphology

Selections of populations typifying the new entities (Table 1) were subjected to assessment of spikelet and floret characteristics in comparison to some typical *L. filiformis*, *L. aemula* and *L. adamsonii* collections. Comparisons were made by selecting and measuring four mature spikelets of a specimen from four separate populations for each taxon.

Considering the range of existing forms of *L. filiformis* and *L. aemula*, the choice of suitable populations for this comparison was not straight forward. For *L. filiformis*, it was decided to use the 'typical' hairy-lemma, narrow-leaf, weeping inflorescence form, commonly found across southern Australia, particularly on roadsides, in drainage ditches and waste places (denoted as A). This is the form that is also indigenous to New Zealand and a number of Pacific Islands and introduced to the western USA. In addition, a selection of more perennial-like forms with thick culms (2.5–3.0 mm), large inflorescences and relatively wide leaves (3–4 mm) were also measured (denoted as B) to compare with *L. perennis*.

Two separate groups of *L. aemula* were also represented in the comparison. The first from the Mount Lofty Ranges in South Australia (denoted as A) as a direct comparison with *L. perennis* and the second from the South Australian/Victoria border and western Wimmera region (denoted as B) to compare with *L. palustris* and *L. leviseta*. These populations were identified as *L. aemula*, rather than *L. filiformis* on the basis of their stiff and rather scabrid leaves, stiff, erect inflorescences and relatively large spikelets. The form of *L. aemula* found across the plains of south-west Victoria with very large spikelets (commonly 6.5–8.5 mm long) that has been previously used in comparison work with *L. billardierei*, *L. punicea* and *L robusta* (Brown & Walsh 2000; James *et al.* 2002) was not used here.

A typical population of *L. adamsonii* with completely glabrous lemmas (except for the callus) was used as a comparison to *L. batesii* because of the reduced awn in both entities.

Growth Study

In order to study growth characteristics and vegetative morphology, seed of a wide range of *Lachnagrostis* populations from South Australia and Victoria was sown into seedling mix (potting mix, sand and perlite) under glasshouse nursery conditions on 26th September 2001. Table 2 provides details of the accessions reported here. Results for other accessions used in the pot study, including those of *L. billardierei*, *L. robusta*, *L. punicea*, *L. adamsonii*, *L. filiformis* and *L. aemula* are planned for future publication. *Lachnagrostis leviseta* was only recognised from field collections after the pot study and therefore was not included at the time and obviously the sterile *L.* ×*contracta* could not be grown from seed.

At 3-4 leaf stage, seedlings were pricked out into forestry tubes containing starter potting mix and again transferred to 10 cm nursery pots on 21st November 2002

Table 2. *Lachnagrostis* seed accessions grown from September 2001 to March 2002 (* new taxa).

Accession code	Species	Seed source location	Voucher specimen	No. of potted plants Nov/Jan – Jan/Mar
MMC	*L. adamsonii*	Barunah, Vic.	*Brown* 1113 (MEL)	8 – 4
SAS2	*L. aemula*	Scott Creek CP, SA	*Bates* 58025 (MEL)	4 – 4
SSe	*L. deflexa**	Streatham, Vic.	*Brown* 871 (AD, NSW, CANB, MEL, HO)	2 – 2
SAA	*L. batesii**	Aldgate Valley, SA	*Bates* 58038 (MEL)	8 – 4
SAS1	*L. batesii**	Scott Creek CP, SA	*Bates* 58030 (MEL)	10 – 8
WM	*L. filiformis*	Connewarren, Vic.	*Brown* 1119 (MEL)	8 – 4
NAN	*L. palustris**	Nangwarry, SA	*Bates* 58010 (AD, MEL)	8 – 4
SAH2	*L. perennis**	Hindmarsh Valley, SA	*Bates* 58026 (MEL)	8 – 4
SAM	*L. perennis**	Mount Adam, SA	*Bates* 57934 (AD, MEL)	8 – 4

Table 3. Comparison of means of morphological characters of four spikelets and florets from each of three or four field collections of new *Lachnagrostis* taxa and compared to collections of *L. filiformis*, *L. aemula* and *L. adamsonii*; mean values in the same column that share the same letter are not significantly different (ANOVA t-test lsd: $p = 0.001$).

Species	Popl	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Ab:Ac	Re	Pt	A
L. adamsanii	1	2.5	2.7	0.0	1.9	0.0	0.0	85	1.8	na	1.1	1.8	0.4
	2	2.7	2.8	0.2	2.2	0.1	0.0	70	2.2	na	1.6	1.8	0.5
	3	2.7	2.9	0.0	2.2	0.0	0.0	72	2.3	na	1.3	1.8	0.5
	4	3.0	3.0	0.0	2.4	0.0	0.0	69	2.1	na	1.5	2.1	0.5
	mean	*2.7*	*2.9*	*0.0*	*2.2*	*0.0*	*0.0*	*74*	*2.1*	na	*1.3*	*1.9*	*0.5*
		b	*c*	*a*	*f*	*a*	*a*	*c*	*b*	na	*b*	*c*	*bc*
***L. aemula* A**	1	4.2	3.6	0.0	1.9	0.3	0.4	45	5.1	2.0	1.6	1.6	0.7
	2	3.7	3.4	0.0	1.9	0.1	0.5	56	5.3	1.5	2.0	1.6	0.6
	3	4.2	3.8	0.0	1.9	0.1	0.3	46	5.8	1.7	1.8	1.7	0.6
	4	4.2	4.0	0.1	2.1	0.2	0.4	47	6.8	1.9	2.1	1.7	1.0
	mean	*4.1*	*3.7*	*0.0*	*2.0*	*0.2*	*0.4*	*48*	*5.8*	*1.8*	*1.9*	*1.6*	*0.7*
		d	*ef*	*a*	*de*	*b*	*de*	*a*	*ef*	*ab*	*c*	*b*	*de*
***L. aemula* B**	1	5.2	4.2	0.2	2.1	0.1	0.5	51	6.5	1.8	1.9	1.7	0.7
	2	4.3	3.7	0.1	1.9	0.1	0.5	48	5.2	2.0	1.5	1.5	0.6
	3	4.6	4.2	0.1	2.0	0.2	0.6	51	7.1	2.2	1.8	1.5	0.7
	4	4.3	4.1	0.1	2.2	0.2	0.5	48	6.8	1.7	2.0	1.7	0.7
	mean	*4.6*	*4.0*	*0.1*	*2.1*	*0.2*	*0.5*	*50*	*6.4*	*1.9*	*1.8*	*1.6*	*0.7*
		e	*fg*	*a*	*ef*	*b*	*ef*	*a*	*f*	*ab*	*c*	*b*	*de*
L. batesii*	1	2.5	2.5	0.0	2.0	0.1	0.5	72	1.8	na	1.1	1.5	0.3
	2	2.0	1.9	0.1	1.6	0.0	0.4	64	1.4	na	0.8	1.2	0.3
	3	2.4	2.4	0.0	2.0	0.1	0.6	71	1.8	na	1.1	1.5	0.3
	4	2.2	2.2	0.1	1.7	0.1	0.5	67	1.6	na	0.5	1.2	0.3
	mean	*2.3*	*2.2*	*0.0*	*1.8*	*0.1*	*0.5*	*68*	*1.7*	na	*0.9*	*1.4*	*0.3*
		a	*a*	*a*	*bc*	*ab*	*ef*	*bc*	*b*	na	*a*	*ab*	*a*
L.* ×*cantracta*	1	4.0	4.1	0.8	2.1	0.1	0.0	71	2.7	na	1.3	1.9	0.8
	2	4.6	4.2	1.2	2.3	0.1	0.0	70	3.9	na	1.0	2.0	0.6
	3	4.2	4.5	0.8	2.3	0.1	0.2	68	3.7	na	1.1	2.0	0.6
	mean	*4.2*	*4.3*	*0.9*	*2.2*	*0.1*	*0.1*	*70*	*3.5*	na	*1.1*	*2.0*	*0.6*
		d	*gh*	*b*	*f*	*ab*	*ab*	*bc*	*c*	na	*ab*	*c*	*cd*
L. deflexa*	1	5.0	4.8	1.6	2.6	0.5	0.2	50	5.9	2.7	1.8	2.2	0.7
	2	4.6	4.5	1.1	2.3	0.4	0.2	55	5.1	2.7	1.5	1.9	0.6
	3	4.5	4.4	1.2	2.4	0.4	0.1	51	5.5	3.1	1.7	2.0	0.6
	4	5.3	4.9	1.5	2.8	0.5	0.2	46	5.8	3.1	1.8	2.1	0.7
	mean	*4.8*	*4.7*	*1.3*	*2.5*	*0.5*	*0.2*	*50*	*5.6*	*2.9*	*1.7*	*2.0*	*0.6*
		e	*h*	*c*	*g*	*c*	*bc*	*a*	*e*	*c*	*c*	*c*	*cd*
***L. filifarmis* A**	1	3.2	2.9	0.1	1.4	0.0	0.3	54	3.9	1.7	0.9	1.2	0.3
	2	2.8	2.7	0.2	1.7	0.0	0.3	46	4.5	2.1	1.5	1.5	0.5
	3	3.2	3.0	0.1	1.6	0.1	0.3	55	4.4	2.0	1.0	1.3	0.3
	4	2.9	2.8	0.1	1.8	0.2	0.3	42	5.1	2.6	1.4	1.6	0.5
	mean	*3.0*	*2.8*	*0.1*	*1.6*	*0.1*	*0.3*	*49*	*4.5*	*2.1*	*1.2*	*1.4*	*0.4*
		b	*bc*	*a*	*a*	*ab*	*cd*	*a*	*d*	*b*	*ab*	*ab*	*ab*

Table 3. Cont.

Species	Popl	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Ab:Ac	Re	Pt	A
L. filiformis B	1	3.1	2.8	0.0	1.6	0.1	0.3	63	4.1	2.8	1.2	1.3	0.3
	2	3.9	3.5	0.1	1.6	0.1	0.4	54	5.7	2.1	1.2	1.4	0.3
	3	3.6	3.4	0.2	1.7	0.0	0.4	54	4.5	2.2	1.1	1.2	0.3
	4	3.6	3.3	0.1	1.9	0.1	0.3	54	4.9	2.0	1.4	1.4	0.4
	mean	3.6	3.3	*0.1*	*1.7*	*0.1*	*0.3*	*56*	*4.8*	*2.3*	*1.2*	*1.3*	*0.3*
		c	*d*	*a*	*ab*	*ab*	*cd*	*ab*	*d*	*b*	*ab*	*a*	*a*
*L. leviseta**	1	3.7	3.6	0.0	2.0	0.1	0.7	94	0.2	na	1.9	1.6	0.8
	2	3.8	3.6	0.1	2.0	0.1	0.5	83	0.5	na	2.0	1.7	0.8
	3	3.7	3.4	0.0	1.9	0.1	0.5	74	0.0	na	2.0	1.7	0.8
	4	3.5	3.2	0.0	1.8	0.1	0.5	83	0.1	na	1.8	1.5	0.8
	mean	*3.7*	*3.4*	*0.0*	*1.9*	*0.1*	*0.6*	83	*0.2*	na	*1.9*	*1.6*	*0.8*
		c	*de*	*a*	*cd*	*ab*	*f*	*d*	*a*	na	*c*	*b*	e
*L. palustris**	1	3.4	3.1	0.0	1.7	0.1	0.4	51	5.1	1.6	1.3	1.4	0.5
	2	3.4	3.1	0.0	1.7	0.2	0.4	47	5.3	1.6	1.4	1.3	0.5
	3	3.6	3.2	0.0	1.8	0.2	0.5	50	5.8	1.4	1.4	1.5	0.5
	4	3.6	3.2	0.0	1.6	0.1	0.4	53	5.9	1.9	1.2	1.3	0.5
	mean	*3.5*	*3.2*	*0.0*	*1.7*	*0.1*	*0.4*	*50*	*5.5*	*1.6*	*1.3*	*1.3*	*0.5*
		c	*d*	*a*	*ab*	*ab*	*de*	*a*	e	*a*	*b*	*a*	*bc*
*L. perennis**	1	2.5	2.3	0.0	1.4	0.0	0.4	70	4.4	3.2	1.3	1.2	0.6
	2	2.7	2.6	0.0	1.6	0.0	0.5	65	5.2	3.3	1.5	1.3	0.5
	3	3.2	2.9	0.0	1.7	0.0	0.4	59	4.0	2.4	1.1	1.5	0.6
	4	3.0	2.8	0.0	1.6	0.1	0.5	57	5.0	2.5	1.0	1.4	0.6
	mean	*2.8*	*2.6*	*0.0*	*1.6*	*0.0*	*0.4*	63	*4.6*	*2.9*	*1.2*	*1.3*	*0.6*
		b	*b*	*a*	*a*	*a*	*de*	*b*	*d*	c	*ab*	*a*	*cd*
LSD	popl	0.3	0.2	0.1	0.1	0.1	0.1	7	0.6	0.3	0.3	0.2	0.1
LSD	means	0.5	0.5	0.2	0.3	0.2	0.2	13	1.3	0.7	0.5	0.3	0.1

* new taxa; Glt = total (including setae) lower glume length (mm); Gut = total upper glume length (mm); Gls = lower glume setae length (mm); Lt = total lemma length (mm); Ls = lemma setae length (mm); H = lemma hair length (mm); Aa = awn attachment from lemma base (%); At = total awn length (mm); Ab:Ac = awn bristle to awn column ratio; Re = rachilla extension length including hairs (mm); Pt = total palea length (mm); A = anther length (mm); na = not applicable.

(week 8 from sowing). Plants were removed from the glasshouse at this stage and placed on outdoor benches at the Department of Primary Industries Werribee Centre (formerly the State Chemistry Laboratory), Victoria. Water was applied as required with an overhead sprinkler but after a very hot weekend in mid December, when plants were observed to suffer stress, they were automatically watered twice/day. On 16th January 2002 (week 17) some plants of each accession were re-potted into 20 cm pots and grown on until 6th March 2002 (week 23).

Measurements of plant height, leaf colour, leaf width (to the nearest 0.5 mm), time to inflorescence emergence and inflorescence number were made periodically throughout the season. Measurements of vegetative, inflorescence and spikelet characteristics of these cultivated plants were compared to herbarium and field collections of the same entities. For statistical purposes, four of the potted plants for each accession (except SSe with only two pots) were sampled when inflorescences were mature and measurements of the characters of four selected spikelets/pot were made. Statistical differences were tested using Genstat 8.1 (Release PL16, Lawes Agricultural Trust, Rothamstead Experimental Station) for ANOVA. Test of significant difference (t-test) between means was set at LSD for a confidence level of 0.1% ($p = 0.001$).

The automatic watering was turned off at the end of the flowering season but the pots were left on the outdoor benches to receive rainfall alone. Plants were reassessed in August 2002 in terms of survival and vigour and counts of inflorescence numbers were made periodically over the following season.

Results and Discussion

Spikelet Morphology

Comparisons in spikelet and floret measurements between collections are presented in Table 3. The following notes outline the major differences observed between the new entities and current taxa.

L. deflexa

The most obvious difference between this taxon and *L. filiformis* (with which it probably has the greatest affinity) was the long setae at the glume apices. It also differed from *L. filiformis* (A & B) in its longer glumes (even with setae excluded), lemma, lemma setae, palea and anthers. Awn length, awn bristle:column and rachilla extension length were generally greater, while lemma hairs were shorter. The glumes of *L. deflexa* often had finely scaberulous surfaces and ciliate margins while the glumes of *L. filiformis* were normally smooth with entire margins. Lemmas of *L. deflexa* had glabrous dorsal surfaces but with some scattered hairs towards the margins, whereas the dorsal and lateral surfaces of lemmas of *L. filiformis* were hairy, to at least some extent.

L. ×contracta

This entity had comparable or overlapping ranges in glume, glume setae, lemma, palea and anther lengths to *L. deflexa* but had shorter lemma setae, awns and rachilla extensions. Awns were straight, curved or flexuose but not obviously geniculate like *L. deflexa*. Glumes were similarly scabrid and ciliate to *L. deflexa*. Lemmas were entirely glabrous or had an occasional hair near the margins. Although reproductive parts were present, anthers lacked pollen and seed was either undeveloped or replaced with ergot (an engorged receptacle of smut fungi).

L. batesii

Glumes, lemmas, awns and rachilla extensions were generally shorter in *L. batesii* compared to *L. adamsonii* but ranges in values did overlap. Palea and anther length were always shorter in *L. batesii*. Compared to *L. filiformis* A, *L. batesii* had overlapping ranges in lemma, palea, rachilla extension and anther lengths but glumes were always shorter. The lemmas of *L. batesii* have glabrous dorsal surfaces or have an occasional hair but with margins that are lightly to moderately hairy. The lemma hairs of *L. batesii* are significantly longer than for *L. filiformis* (at least for the populations used in this assessment). The lateral surfaces of the glumes of *L. batesii* were often finely scabrid, whereas those for *L. adamsonii* and *L. filiformis* were generally smooth.

L. perennis

In comparisons of means with *L. aemula* (A & B), *L. perennis* had significantly shorter glumes, lemmas, awns, rachilla extensions and paleas. In all of these features, *L. perennis* was more comparable to *L. filiformis* A and to *L. filiformis* B, except for the significantly longer glumes of the latter (at least for collections 2, 3 and 4). Anthers in both groups and all collections of *L. filiformis* were significantly shorter than in *L. perennis*, which had anther lengths similar to *L. aemula*. In comparison to both groups of *L. aemula* and *L. filiformis*, with the exception of collection 1 of *L. filiformis* B, the awns of *L. perennis* had a higher bristle to column ratio and were inserted on average, 10% higher on the lemmas.

In other features, the glumes of *L. perennis* often had less scabrid keels and a firmer texture. While *L. aemula* and *L. filiformis* generally had transparent glumes, particularly towards the margins, the glumes of *L. perennis* were opaque or translucent throughout. Lemmas of *L. perennis* were densely hairy with long hairs like *L. aemula* and less like the only moderately hairy *L. filiformis* with its shorter hairs.

L. palustris

Spikelet and floret characteristics were significantly smaller in this taxon than for *L. aemula* B in all measurements, except that there was overlap in the range of means for the length of awns. This was also the case when comparing *L. palustris* with *L. aemula* A. In comparison with *L. filiformis* A, *L. palustris* had significantly

longer glumes and awns, while other measures were comparable or overlapped. Like *L. aemula*, the taxon generally had glumes without (or few) marginal cilia or scaberulous laterals. Lemmas were more or less covered with dense hairs, whereas *L. aemula* tended to be bare in the upper ¼ of the lemma back.

L. leviseta

Apart from the obvious lack of a significant awn, *L. leviseta* differs from *L. aemula* B in its smaller glumes and slightly longer anthers. From *L. palustris*, it differs in its generally longer lemmas, paleas, rachilla extensions and anthers. Although *L. leviseta* had comparable lemma hair density, it often displayed longer hairs than the other two taxa (mean of 0.6 mm compared to 0.4 mm and 0.5 mm for *L. palustris* and *L. aemula* respectively), though this feature varied from plant to plant.

Growth Study

Table 4 provides results of the plant growth study for the accessions. Under the well watered conditions of the study, undoubtedly assisted by the favourable nursery conditions for early development, tussocks generally grew more vigorously and produced wider and longer leaves with less in-rolling than commonly observed in the field. Also, it is probable that the potted plants produced more inflorescences than under field conditions. Nevertheless, relative morphological differences between taxa, observed in field populations, were upheld.

L. deflexa

In comparison to *L. filiformis*, this taxon displayed wider leaves, greater tiller formation and significantly more inflorescences (despite being three weeks later in emergence). These taxa appear to have a similar response to water stress; showing severe leaf wilting and death.

Both taxa displayed some leaf in-rolling by late winter. The two plants of *L. deflexa* had about 30–40% green leaf, whereas *L. filiformis* ranged from 10–30% green leaf and the weaker plants did not flower during the second season. The stronger plants of *L. filiformis* produced a similar average number of inflorescences to *L. deflexa* (35 and 39/plant respectively) but considerably fewer than for the first season's production. First inflorescence emergence was some 3–4 weeks earlier for both taxa, compared to the previous season.

L. batesii

Compared to *L. adamsonii*, this taxon displayed no significant differences in the measured growth parameters. Other observed growth characteristics however, were distinct between the two entities. The outer tillers of the tussocks were generally prostrate for *L. batesii* but erect for *L. adamsonii*. Flag leaves of *L. batesii* were often shorter than for *L. adamsonii* and tended to develop a purplish or reddish colouration on the lower surface, along with the upper leaf sheath. Stress due to summer drought appeared to affect *L. batesii* more so than *L. adamsonii* with more leaf wilting and death. Inflorescence emergence was earlier in *L. batesii* by 1–2 weeks but peak numbers were not too dissimilar.

By late winter (August 2002), *L. batesii* leaves remained flat whereas *L. adamsonii* leaves had in-rolled in response to the changed environmental conditions. The *L. adamsonii* tussocks had about 30–40% green leaves, whereas 8 of the 12 pots of *L. batesii* had 20% or less green leaves. Despite the low percentage of green leaves, all the *L. batesii* plants survived and flowered, although 3 of the pots with only 5% green material may have represented new seedlings growing from the centres of old dead tussocks. Compared to the first season, considerably fewer inflorescences were produced in the second season; averaging 10 inflorescences/plant for *L. adamsonii* and 27 and 43 for the *L. batesii* accessions (with only 3–4 late inflorescences for the 3 weak tussocks and an average of 47 inflorescences for the remainder). First emergence was ten days earlier in *L. adamsonii* and at least five weeks earlier in *L. batesii* compared to season one. Although most accessions tested in this study produced abundant new seedlings from self-sown seed, those of *L. batesii* seem to predominate and were found as invaders in most other trial pots during the second season.

L. perennis

This taxon produced significantly wider leaves than *L. filiformis* and eventually taller inflorescence culms.

Leaves for accession SAM were always significantly wider than for SAH2, suggestive of some genetic diversity within the taxon. Inflorescence emergence was 1–2 weeks later than for *L. filiformis* and peak numbers were 16–39% lower. In comparison to *L. aemula*, early plant height (12 weeks post sowing) and inflorescence culm height were greater. Early tillers were prostrate in *L. perennis* and erect in *L. aemula*. Inflorescence emergence was 4–5 weeks earlier and peak numbers were from 3–4 times higher. The inflorescences of *L. perennis* remained pale green throughout maturity, while those of *L. filiformis* developed a slight purplish cast and those of *L. aemula* became strongly purple-red.

Late winter observations showed that both *L. aemula* and *L. perennis* had retained flat leaves compared to the part leaf inrolling of *L. filiformis*. Whereas *L. aemula* had about 5–20% green leaf at this time, *L. perennis* had 20–30%. Accession SAM of *L. perennis* and accession SAS2 of *L. aemula* produced very few inflorescences (1–5 for the former and 5 from one plant only for the latter) in the second season. By contrast SAH2 (*L. perennis*) produced an average of 23 inflorescences/plant (about half of first season results).

Table 4. Means and ranges of plant measurements for pots in the growth study of *Lachnagrostis* accessions (*new taxa).

Measurement	MMC *adamsonii*	SAS2 *aemula*	SAA *batesii**	SAS1 *batesii**	SSe *deflexa**	WM *filiformis*	NAN *palustris**	SAH2 *perennis**	SAM *perennis**
8 weeks post sowing (21st November)									
Tussock height, cm	21 (14-26)	26 (24-28)	24 (14-27)	22 (20-27)	22 (21-22)	27 (21-34)	16 (13-20)	28 (24-33)	26 (21-29)
No. of tillers	13 (7-36)	12 (7-16)	18 (16-19)	21 (12-32)	35 (34-36)	18 (10-27)	21 (14-28)	11 (6-14)	12 (5-17)
Leaf width, mm	2.0 (1.5-2.5)	5.4 (5.0-5.5)	3.7 (2.0-4.5)	3.4 (2.5-4.0)	3.0 (3.0-3.0)	2.6 (2.0-3.0)	1.4 (1.0-2.0)	4.6 (4.0-5.0)	5.8 (5.5-6.0)
12 weeks post sowing (19th December)									
Tussock height, cm	25 (20-32)	25 (23-26)	30 (25-36)	32 (27-39)	22 (20-25)	26 (20-32)	18 (12-24)	31 (26-36)	29 (25-35)
Leaf width, mm	4.2 (3.0-5.0)	6.9 (6.5-7.0)	6.7 (4.0-8.0)	4.8 (3.5-6.0)	6.3 (6.0-6.5)	4.7 (4.0-5.5)	2.2 (1.5-3.0)	7.3 (6.0-8.0)	9.8 (8.0-11.0)
14 weeks post sowing (3rd January)									
Tussock height, cm	24 (18-35)	30 (25-32)	26 (20-41)	21 (18-26)	30 (30-31)	28 (22-31)	20 (15-31)	36 (21-45)	32 (29-35)
Inflor. height, cm	36 (33-40)		39 (35-44)	46 (33-60)		39 (31-45)		39 (25-47)	
Leaf width, mm	4.3 (3.0-5.0)	6.3 (5.0-7.5)	6.0 (4.0-7.5)	4.5 (3.5-5.5)	6.3 (5.0-6.5)	4.7 (4.0-5.5)	2.8 (1.5-3.5)	6.9 (5.0-7.5)	9.0 (7.5-10.5)
20 weeks post sowing (13th February)									
Inflor. height, cm	58 (47-70)	48 (46-49)	54 (48-60)	52 (48-57)	52 (48-55)	61 (45-71)	47 (37-66)	79 (72-91)	76 (71-82)
Leaf width, mm	2.6 (2.0-3.5)	6.9 (5.5-8.0)	4.3 (4.0-4.5)	3.5 (2.0-4.5)	5.0 (4.5-5.5)	3.3 (3.0-3.5)	2.0 (1.5-2.5)	4.8 (4.0-5.5)	6.5 (6.0-7.0)
Emergence of 1st inflorescence, weeks post sowing	14	19	13	12	16	13	16	14	15
Mean inflorescence number/pot at peak	84	12	71	89	90	57	109	48	35

L. palustris

Plant height (at least in early growth) and leaf width (throughout) was significantly less for *L. palustris* than for *L. aemula*. Early tillers were erect in both taxa. Inflorescence emergence was 3 weeks earlier in *L. palustris* and peak numbers were 10 times greater. On or within a couple of days of emergence, inflorescences of *L. palustris* (rachis, branches, pedicels and spikelets) were distinctly purple, whereas purpling of *L. aemula* inflorescences tended to develop with maturity. On maturing however, the purple colouration of *L. palustris* faded to a pale golden brown whereas the purpling of *L. aemula* was more permanent.

Both *L. aemula* and *L. palustris* had low green leaf content in late winter, with only one plant of each with 20% or more. Leaves of *L. palustris* were in-rolled by this stage. First emergence of inflorescences in *L. aemula* and *L. palustris* for the second season occurred about one month and three months earlier, respectively, than in the first season. The number of *L. palustris* inflorescences peaked at an average of 45/plant (about half of the first season average).

Tables 5 and 6 show comparisons in vegetative, inflorescence and spikelet characteristics between a typical plant of the original seed source population and specimens of the plants derived from the pot study. Although some difference in plant age at collection may have occurred for some accessions (e.g. emergence or non-emergence of inflorescence, in-rolling of older leaves), most measured features for most accessions are comparable.

The main vegetative character showing major difference between field and potted plants was the width of lower or tussock leaves (Table 5). In all cases,

Table 5. Comparison of vegetative and inflorescence morphology between a typical plant from each of the original seed sourced field populations and the range in plants grown in the pot growth study.

Accession	Species	Plant source	Lower leaf width, mm[1]	Flag leaf width, mm	Flag leaf length, cm	Ligule, mm[2]	Inflores. l × w, cm[3]	Peduncle, cm[4]
MMC	*L. adamsonii*	Field	1.5r	1.5r	5	5	22 × 10c	0
		Pot	3-5f	0.5-1r	2-8	3-5	32 × 24	2.5-9
SAS2	*L. aemula*	Field	4f	4f	11	8	34 × 27	9
		Pot	5-7.5f	3-5f	11-15	5-9	36 × 33	5-11
SAA	*L. batesii**	Field	3.5f	2f	6	2	16 × 14	2
		Pot	4-7.5f	1.5-2f	4-9	2-5	22 × 19	7-15
SAS1	*L. batesii**	Field	2.5f	0.5r	5	4	18 × 13	0
		Pot	3.5-5.5f	1.5f 0.5-1r	2.5-3.5	3-5	18 × 19	1-18
SSe	*L. deflexa**	Field	3f	1r	11	8	19 × 6c	0
		Pot	5-6.5f	2f 1.5r	6-6.5	6-7	20 × 13	8.5
WM	*L. filiformis*	Field	1.5f	2f	9.5	6	25 × 25	0
		Pot	4-5.5f	1-2f	4.5-9	4-6	28 × 29	3-8
NAN	*L. palustris**	Field	1.5r	0.5r	5	6	17 × 16	1.5
		Pot	1.5-3.5f	1.5-2.5f 0.5-1r	3-6	5-6	21 × 26	8-12
SAH2	*L. perennis**	Field	4f	2f	8	7	26 × 26	5
		Pot	5-7.5f	1-2.5f 1-1.5r	5.5-11.5	4-5	30 × 24	10.5-12
SAM	*L. perennis**	Field	4f	3f	12	8	15 × 17	16
		Pot	7.5-10.5f	3-4f 2.5r	9-16	4-8	33 × 29	11-16

* new taxa, [1] data for potted plants taken from 14 weeks post sowing, [2] ligule of the flag leaf, [3] largest inflorescence length (from lowest whorl) x width, [4] length of emerged peduncle, f = flat, r = inrolled or folded, c = contracted

Key to taxa Lowland south-east Australia

1 Leaves flat or loosely folded/involute (particularly on drying out), generally mid-green when young; culms often leafy (leaf blades above the main tussock often long and overlapping) 2

1: Leaves tightly conduplicate/involute, often bluish-green when young; culms not particularly leafy (leaf blades above the main tussock often short and not overlapping) 13

2 Leaves generally less than 3 mm wide (often less than 2 mm) or if wider, soft or lax and never firm or stiff (though they may still be scaberulous); panicle often enclosed by the upper leaf sheath until mature; lemma moderately hairy (lower dorsal surface readily visible) to near-glabrous 3

2: Leaves generally 3 mm wide or more (or some leaves to 3 mm and the majority of at least 2 mm) and rather firm to stiff; panicle often well exserted from early development; lemma either very hairy (lower dorsal surface obscured) or completely glabrous (except for the callus) 9

3 Glumes with finely scabrous lateral surfaces, marginal cilia and strongly scabrous keels ending in setae points 0.7 mm long or more (taxa of central south-west Victoria) 4

3: Glumes not entirely as above 5

4 Awn well developed, geniculate and inserted at about ½ lemma length; mature panicle spreading above but with strongly deflexed branches below ..... *5. L. deflexa*

4: Awn reduced to a straight or curved non-geniculate bristle and inserted at about 2/3 of lemma length; mature panicle with erect and slightly divaricate primary branches but appressed secondary and tertiary branches ..... *6. L. ×contracta*

5 Awn well developed, geniculate and inserted at about ½ lemma length ..... *L. filifarmis*

5: Awn absent or variously reduced to a minute point or a straight to curved bristle and inserted near lemma apex 6

6 Glume margins and lemma and palea apices lacking cilia 7

6: Glume margins and lemma and palea apices ciliate or fimbriate 8

7 Lemma ½ to ¾ the length of the glume; awn absent or less than 1.0 mm ..... *L. limitanea*

7: Lemma more than ¾ the length of the glume; awn 1.2 mm or more ..... *1. L. batesii*

8 Lemma awn absent or less than 1.0 mm ..... *L. scabra subsp. scabra*

8: Lemma awn more than 1.0 mm ..... *L. scabra subsp. curviseta*

9 Most spikelets 3.5 mm long or less; panicle branches and spikelets never becoming strongly purple with maturity 10

9: Most spikelets longer than 3.5 mm; panicle branches and spikelets often becoming strongly purple with maturity 11

10 Panicle more or less erect or slightly drooping, all branches and spikelets remaining pale green until senescence; glumes less than 3.5 mm long, acute, rather firm, laterals opaque to translucent; anthers mostly 0.5–0.6 mm long ..... *2. L. perennis*

10: Panicle drooping to weeping, terminal branches and spikelets often developing a purplish or greyish cast with maturity; glumes generally more than 3.0 mm long, acuminate, rather thin, generally transparent near the margins; anthers mostly 0.3–0.4 mm long ..... *L. filifarmis*

11 Lemma covered in hairs in the lower ¾ ..... *L. aemula*

11: Lemma glabrous (except for the callus) 12

12 Awn absent or reduced to a straight bristle, not or hardly exceeding the glumes (Bass Strait Islands and Tasmania) ..... *L. billardierei subsp. tenuiseta*

12: Awn well developed, geniculate, easily exceeding the glumes ..... *L. billardierei subsp. billardierei*

13 Awn absent (or appearing so) or if present, reduced to a straight or curved bristle, inserted near lemma apex (or at least, well above the mid-dorsal region) 14

13: Awn well developed, geniculate and inserted well below lemma apex 15

Cont. Key to taxa

14 Awn absent or less than 0.5 mm long (or occasional awn to 2.5 mm); lemma covered with long hairs ..... 4. ***L. leviseta***

14: Awn 1.0 mm or more long; lemma glabrous or with scattered short hairs ..... ***L. adamsonii***

15 Awn inserted within lower ¼ of lemma length; palea setae mainly 0.4 mm long or more; leaves mainly conduplicate 16

15: Awn inserted at or above ¼ of lemma length; palea setae mainly less than 0.4 mm long; leaves mainly involute 17

16 Lemma covered in hairs in the lower ¾ ..... ***L. punicea subsp. punicea***

16: Lemma glabrous (except for the callus) ..... ***L. punicea subsp. filifolia***

17 Lemma hairy 18

17: Lemma hairless (except for the callus) but strongly scaberulous in upper half ..... ***L. robusta***

18 Lower glume more than 3.0 mm long; emerging panicles strongly purple and rather stiffly erect; leaves bluish- or purplish-green ..... 3. ***L. palustris***

18: Lower glume 3.0 mm long or less; emerging panicles purplish or green and lax; leaves mid-green ..... ***L. sp.***

except for *L. palustris*, lower leaves of potted plants were considerably wider than those collected in the field. This difference in leaf width was not apparent in flag leaves. In a few accessions, flag leaf length was longer in field collections. If environmental conditions can play such a large role in leaf size, then its use as a diagnostic criterion needs to be carefully considered. Ligule length was highly variable within most accessions, which on closer examination often related to the degree of laceration displayed at the apices.

Maximum inflorescence size was similar, regardless of growing conditions, except for accessions MMC and SAM where pot conditions were more favourable (Table 5). The degree of inflorescence emergence was generally in favour of the potted plants but whether this was due to maturity differences or to more vigorous culm elongation cannot be ascertained. What was obvious however, was the prolific production of inflorescences for most accessions under potted conditions, compared to the numbers normally observed, but almost never measured, in the field. Past field observations do note that tussocks of this genus readily respond to rainfall by producing new batches of inflorescences with each event. It may be that under normal field conditions of variable wetting and drying, inflorescences do not persist for long but flowering and seed set develop more quickly than under favourable moisture conditions. Study of plant response under field conditions could therefore be a useful pursuit, particularly when assessing the 'normality' of growth characteristics under nursery and/or potted conditions.

Spikelets and florets of potted plants were not significantly different from field plants for most accessions and characteristics (Table 6). Glume setae in *L. deflexa* were however, significantly shorter in field plants (therefore contributing to overall shorter glumes) but as these setae become somewhat fragile with maturity, it is likely that some had broken tips. Lemmas in field plants of *L. adamsonii* and *L. batesii* (SAS1 only) were slightly but significantly longer than in potted plants. Some significant variation among the potted plants of the same accession was apparent for glume length in *L. filiformis* and *L. adamsonii*, lemma length in *L. adamsonii* and *L. perennis* (SAM), awn length in *L. aemula* and anther length in *L. palustris*. This variation needed to be considered when determining useful diagnostic criteria for separating taxa.

Pot studies have been useful in demonstrating the maintenance of morphological differences among taxa observed in the field. However, vegetative characters of potted plants (e.g. leaf width) could not be used as a diagnostic criteria for field collected specimens.

Taxonomy

1. *Lachnagrostis batesii* A.J.Br. *sp. nov.*

Gramen parvum caespitosum, annuum vel perenne bevivivum, ad 40 cm altum. Culmi ascendentes numerosi, panuculae

Table 6. Comparison of means of characters of four spikelets of plants from each of the original seed source field populations and those subsequently grown in the pot growth study; mean values for potted accessions in the same column that share the same letter are not significantly different (ANOVA t-test lsd: $p = 0.001$).

Accession	Species	Source	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Re	Pt	A
MMC	*L. adamsonii*	Field	3.0	3.0	0.0	2.4	0.0	0.0	69	2.1	1.5	2.1	0.5
		Pot 1	2.8	3.0	0.0	2.1	0.0	0.0	72	1.9	1.1	1.8	0.5
		Pat 2	2.8	3.0	0.1	2.1	0.1	0.0	73	2.2	1.1	1.8	0.5
		Pot 3	2.5	2.9	0.0	2.1	0.0	0.0	76	1.8	1.0	1.8	0.5
		Pat 4	2.3	2.4	0.0	1.8	0.0	0.0	75	1.7	0.9	1.5	0.4
		Mean	*2.6*	*2.9*	*0.0*	*2.1*	*0.0*	*0.0*	*73*	*1.9*	*1.1*	*1.8*	*0.5*
			b	*c*	*a*	*c*	*a*	*a*	*ef*	*a*	*bc*	*d*	*bc*
SAS2	*L. aemula*	Field	4.2	3.6	0.0	1.9	0.3	0.4	45	5.1	1.6	1.6	0.7
		Pat 1	3.7	3.2	0.1	1.9	0.3	0.6	46	5.8	1.8	1.4	0.6
		Pat 2	3.8	3.6	0.0	1.9	0.2	0.6	47	6.4	1.9	1.6	0.6
		Pat 3	3.9	3.7	0.0	2.0	0.3	0.7	45	6.9	2.1	1.6	0.7
		Pot 4	3.9	3.6	0.0	2.0	0.2	0.6	47	6.4	1.8	1.6	0.7
		Mean	*3.9*	*3.6*	*0.0*	*1.9*	*0.2*	*0.5*	*46*	*6.1*	*1.8*	*1.5*	*0.7*
			d	*e*	*a*	*b*	*b*	*c*	*a*	*e*	*f*	*c*	*d*
SAA	*L. batesii**	Field	2.2	2.2	0.1	1.7	0.1	0.5	67	1.6	0.5	1.2	0.3
		Pot 1	1.9	1.9	0.1	1.6	0.0	0.4	76	1.1	0.7	1.1	0.3
		Pot 2	2.2	2.2	0.0	1.8	0.0	0.5	75	1.8	1.0	1.4	0.3
		Pot 3	2.1	2.1	0.0	1.7	0.0	0.4	64	1.6	0.6	1.1	0.3
		Pot 4	2.1	2.1	0.0	1.7	0.1	0.4	68	1.4	0.6	1.3	0.3
		Mean	*2.1*	*2.1*	*0.0*	*1.7*	*0.0*	*0.5*	*70*	*1.5*	*0.7*	*1.2*	*0.3*
			a	*a*	*a*	*a*	*a*	*c*	*ef*	*a*	*a*	*a*	*a*
SAS1	*L. batesii**	Field	2.4	2.4	0.0	2.0	0.1	0.6	71	1.8	1.1	1.5	0.3
		Pot 1	2.0	2.0	0.0	1.7	0.0	0.5	69	1.5	0.9	1.3	0.3
		Pot 2	2.1	2.1	0.0	1.7	0.0	0.4	79	1.2	0.9	1.3	0.3
		Pat 3	1.9	2.0	0.0	1.7	0.0	0.4	81	1.0	0.9	1.3	0.3
		Pot 4	2.0	2.0	0.0	1.6	0.0	0.4	71	1.4	0.9	1.3	0.3
		Mean	*2.1*	*2.1*	*0.0*	*1.7*	*0.0*	*0.5*	*74*	*1.4*	*0.9*	*1.3*	*0.3*
			a	*a*	*a*	*a*	*a*	*c*	*f*	*a*	*ab*	*ab*	*a*
SSe	*L. deflexa**	Field	4.6	4.5	1.1	2.3	0.4	0.2	55	5.1	1.5	1.9	0.6
		Pot 1	5.0	4.7	1.5	2.3	0.4	0.3	54	5.5	1.7	2.0	0.6
		Pat 2	5.0	5.0	1.6	2.3	0.4	0.3	53	5.9	1.6	1.9	0.7
		Mean	*4.9*	*4.8*	*1.4*	*2.3*	*0.4*	*0.3*	*54*	*5.6*	*1.6*	*1.9*	*0.6*
			e	*f*	*c*	*d*	*c*	*b*	*bc*	*de*	*ef*	*d*	*cd*
WM	*L. filifarmis*	Field	3.2	3.0	0.1	1.6	0.1	0.3	55	4.4	1.0	1.3	0.3
		Pot 1	3.7	3.4	0.2	1.6	0.1	0.4	62	5.1	0.9	1.4	0.3
		Pot 2	3.7	3.5	0.3	1.7	0.1	0.4	58	4.5	1.1	1.3	0.3
		Pot 3	3.1	3.1	0.1	1.6	0.0	0.3	52	4.6	0.8	1.3	0.3
		Pot 4	3.2	3.1	0.2	1.5	0.0	0.4	57	4.4	0.8	1.3	0.2
		Mean	*3.4*	*3.2*	*0.2*	*1.6*	*0.1*	*0.4*	*56*	*4.6*	*0.9*	*1.3*	*0.3*
			c	*d*	*b*	*a*	*ab*	*bc*	*c*	*b*	*ab*	*ab*	*a*

Table 6. Cont.

Accession	Species	Source	Glt	Gut	Gls	Lt	Ls	H	Aa	At	Re	Pt	A
NAN	*L. palustris**	Field	3.6	3.2	0.0	1.7	0.2	0.4	47	5.3	1.4	1.3	0.5
		Pot 1	3.4	3.1	0.0	1.7	0.2	0.5	50	6.0	1.6	1.3	0.4
		Pot 2	3.7	3.4	0.0	1.9	0.1	0.5	51	5.5	1.6	1.5	0.6
		Pot 3	3.6	3.1	0.1	1.8	0.1	0.5	53	5.3	1.5	1.4	0.5
		Pot 4	3.6	3.2	0.1	1.7	0.1	0.5	49	5.2	1.4	1.3	0.5
		Mean	3.6	3.2	*0.0*	*1.7*	*0.1*	*0.5*	*50*	*5.4*	*1.5*	*1.3*	*0.5*
			c	*d*	*a*	*a*	*ab*	*c*	*ab*	*cd*	*de*	*ab*	*bc*
SAH2	*L. perennis**	Field	2.7	2.6	0.0	1.6	0.0	0.5	65	5.2	1.5	1.3	0.5
		Pot 1	2.5	2.4	0.0	1.6	0.0	0.5	65	4.7	1.4	1.3	0.5
		Pot 2	2.7	2.6	0.0	1.6	0.0	0.5	62	4.6	1.5	1.4	0.6
		Pot 3	2.6	2.6	0.1	1.6	0.0	0.5	60	5.0	1.4	1.4	0.5
		Pot 4	2.5	2.4	0.0	1.7	0.0	0.5	60	5.2	1.6	1.4	0.5
		Mean	*2.6*	*2.5*	*0.0*	*1.6*	*0.0*	*0.5*	*62*	*4.9*	*1.5*	*1.3*	*0.5*
			b	*b*	*a*	*a*	*a*	*c*	*d*	*bc*	*de*	*ab*	*bc*
SAM	*L. perennis**	Field	2.5	2.3	0.0	1.4	0.0	0.4	70	4.4	1.3	1.2	0.6
		Pot 1	3.2	2.8	0.0	1.8	0.1	0.5	66	4.8	1.4	1.6	0.5
		Pot 2	2.6	2.4	0.0	1.6	0.1	0.4	67	4.4	1.3	1.3	0.5
		Pot 3	2.9	2.6	0.1	1.5	0.1	0.6	70	4.8	1.1	1.3	0.5
		Pot 4	3.1	2.8	0.0	1.7	0.1	0.6	70	4.9	1.4	1.5	0.5
		Mean	*2.8*	*2.6*	*0.0*	*1.6*	*0.1*	*0.5*	*68*	*4.6*	*1.3*	*1.4*	*0.5*
			b	*b*	*a*	*a*	*ab*	*c*	*e*	*bc*	*cd*	*bc*	*bc*
LSD	accession		0.2	0.2	0.1	0.1	0.1	0.1	5	0.5	0.2	0.1	0.1
LSD	accession *source	0.5	0.4	0.2	0.2	0.1	0.2	12	1.0	0.5	0.3	0.1	

* new taxa, Glt = total (including setae) lower glume length (mm); Gut = total upper glume length (mm); Gls = lower glume setae length (mm); Lt = total lemma length (mm); Ls = lemma setae length (mm); H = lemma hair length (mm); Aa = awn departure from lemma base (%); At = total awn length (mm); Re = rachilla extension length including hairs (mm); Pt = total palea length (mm); A = anther length (mm).

aliquot implexi. Spiculae plerumque 2.0–2.5 mm longae; lemmata dorsaliter glabra sed cum pili prope marginibus, arista ad 2.0 mm longa, inserta circa ¾ e basi lemmatis.

***Type*: SOUTH AUSTRALIA**. Scott Creek Conservation Park, 15.i.2000, *Bates 55750* (holotype: AD).

Mid to light green, tufted, glabrous, *annual or short-lived perennial*, 15–40 cm tall including inflorescences; culms 1.0 mm wide or less, ascending to weakly erect, often lodging with maturity, sometimes branched and somewhat tangled; nodes visible, glabrous, often purple or brown; sheaths smooth, sometimes purplish. *Leaf blades* spreading to lax, generally smooth except for finely scaberulous margins, flat, to 8(–12) cm long and (1–)2–3.5 mm wide; ligule membranous, acute becoming lacerate, 2–5 mm long. *Inflorescence* an open panicle to 25 cm long from the lowest whorl, exserted at maturity with divaricate to spreading, undulating, capillary branches; secondary and tertiary branches strongly flexuous; branches and pedicels green or sometimes with minute purple spots, finely scaberulous. *Spikelets* (1.8–)2.0–2.5 mm long, pale to light green; glumes acute, subequal or sometimes the lower 0.1–0.2 mm longer, keels scabrous, lateral surfaces smooth or finely scaberulous to minutely papillose, margins without cilia; lemma acute, 1.4–2.0 mm long, minutely (0.2 mm or less) 4-toothed at the apex, dorsal surface glabrous or with occasional to few hairs but lateral surfaces towards margins with a moderate covering of 0.4–0.6 mm long hairs, callus with hairs 0.3–0.5 mm long; awn reduced to a bristle inserted from about ¾ of the lemma length, 1.2–2.0 mm long, filamentous, straight or slightly curved; palea ¾ the length of the lemma; rachilla extension plumose,

Figure 1: *Lachnagrostis batesii*: a spikelets ×4; **b** anther ×18; **c** floret ×18; **d** tussock (*Brown 163B* MEL). *L. perennis*: **e** mature panicle ×0.25; **f** leaves and culms ×0.25; **g** immature panicle ×0.25; **h** spikelets ×4; **i** anther ×18; **j** floret ×18 (*Brown 1724* MEL).

Figure 2: Known distribution of *Lachnagrostis batesii* in South Australia.

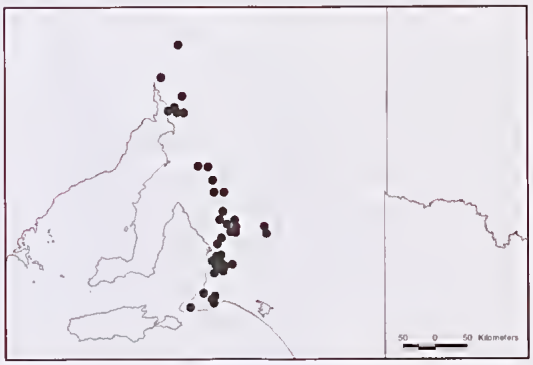

Figure 3: Known distribution of *Lachnagrostis perennis* in South Australia.

0.5–1.3 mm long including hairs; anthers 0.2–0.3(–0.4) mm long (Fig. 1a–d).

Notes: This taxon differs from *L. adamsonii* in its generally smaller glumes, lemmas and anthers, its slightly lower awn attachment and its flat, rather than in-rolled leaves. Its spikelets are of similar size to *L. scabra* but it generally has longer awns and lacks the cilia of the glume margins and fimbriate apices of the lemma and palea that are features of that taxon. Both *L. adamsonii* and *L. scabra* may have some or a few scattered lemma hairs but *L. batesii* always has relatively long hairs towards the margins.

Distribution: Endemic to South Australia. Restricted to the southern Mt. Lofty Ranges from the Fleurieu Peninsula to the Little Para River (Fig. 2).

Ecology: Confined to creek and stream edges and flats.

Etymology: Named after Mr Robert Bates, naturalist of South Australia who, although better known for his work with orchids, has also made extensive collections of grasses over the past 30 years.

Common name: Bates's Blown-grass

Selected specimens examined: **SOUTH AUSTRALIA.** Upper Hindmarsh Waterfall near Victor Harbour, 27.i.1931, *Cleland 24C* (AD); Gawler River, 15.iv.1848 *Mueller s.n.* (MEL); Dismal Creek near Cut Hill, Victor Harbour, 30.xii.1940, *Cleland 24D* (AD); St. Peters, Adelaide, 16.xi.1967, *Kraehenbuehl 2944* (AD); Hindmarsh Valley Falls, 9.iv.1972, *Williams 4120* (AD); River Finniss, Yundi, 18.iii.1984, *Bates 3643* (AD); Creek beside Mylor Oval, xii.1989, *Bates 57945* (AD); Deep Creek below Cherryville, 3.ii.1996, *Bates 42272* (AD); Logania Dam, Bushnet Creek, ii.2000, *Bates 55925* (AD); Mount Compass, near Hindmarsh Falls, 12.iii.2000, *Bates 55025* (AD); Blackfellows Creek, xi.2000, *Bates 57999* (AD); Mylor, Aldgate Valley, 28.i.2001, *Bates 58038* (MEL); Coxs Creek, Bridgewater, iii.2003, *Bates 60572* (AD); Scott Creek at Scott Bottom, 29.xii.2003, *Brown 163B* (NSW, MEL, HO); Devils Nose Gorge, xii.2003, *Bates 61878* (MEL); Aldgate Valley Creek, Aldgate, 14.i.2004, *Bates 62062* (AD); Torrens River near Stoney Creek, 4.ii.2004, *Bates 620B1* (AD); Sturt Creek near Ironbark, iv.2004, *Bates 624B0* (AD); near bridge north of Gumeracha, 30.iv.2004, *Bates 6259B* (AD); Hindmarsh Valley Reserve, vi.2004, *Bates 62793* (AD); Dorset Vale, ii.2005, *Bates 64670* (AD); Cudlee Creek, 20.iii.2005, *Bates 64910* (AD); Little Para River, below SA Water Reservoir, 21.iii.2005, *Bates 64925* (AD); Jupiter Creek South, Mt Bold, xii.2005, *Bates 6749B* (AD).

2. *Lachnagrostis perennis* (Vickery) A.J.Brown *comb. et. stat. nov.* based on *Agrostis avenacea* var. *perennis* Vickery, *Contrib. N.S.W. Natl. Herb.* 1:114(1941).

***Type*: SOUTH AUSTRALIA.** Encounter Bay, i.1925, *Cleland H.242* (holotype: K).

Light to mid green, tufted, glabrous, *perennial*, 50–100 cm tall including inflorescences; culms 1.5–3.0 mm wide, erect, sometimes branching; most nodes enclosed or just extended beyond the leaf sheath, glabrous, generally pale brown; sheaths smooth. *Leaf blades* firm to rather stiff, erect to divergent, uniformly and finely scaberulous on both surfaces, flat, mostly15–25 cm long or flag leaves 5–12 cm long and all leaves (2–)3–5 mm wide; ligule membranous, acute becoming lacerate, 5–10 mm long. *Inflorescence* an open panicle 15–35 cm long from the lowest whorl, exserted at maturity with a visible peduncle 10–20 cm long and stiffly erect to gently drooping, never weeping, remaining relatively narrow until late maturity where it may become divaricate or spreading, the undivided part of a lower panicle branch often much shorter

than half the overall length of the branch; primary branches rather stiff and straight; secondary and tertiary branches straight or gently flexuous; branches and pedicels pale green or sometimes faintly purplish, densely scabrous. *Spikelets* (2.3–)2.5–3.0(–3.5) mm long and 0.4–0.5 mm wide, pale to light green, never with purple colouration; glumes acute, somewhat bulging with floret maturity, subequal or sometimes the lower 0.1–0.3 mm longer, opaque to translucent and rather firm, lower glume keel uniformly scabrous, upper glume keel scabrous to almost smooth, lateral surfaces generally very finely papillose and pale in contrast to the green keel, margins without cilia or occasionally with a few cilia; lemma acute but broad, 1.3–1.8 mm long, minutely (0.1 mm or less) 4-toothed at the apex, covered in 0.4–0.7 mm long hairs, callus with hairs 0.6–0.7 mm long; awn inserted from ½ to ¾ of the lemma length, 3.5–6.0(–6.2) mm long, weakly to strongly geniculate, the bristle often but not always being 3 or more times longer than the column, awns of terminal florets often reduced to short non-geniculate bristles or absent; palea 1.0–1.7 mm long; rachilla extension plumose, 0.8–1.8 mm long including hairs; anthers 0.5–0.6(–0.7) mm long (Fig. 1e–j).

Notes: Jacobs (2001) provided *Lachnagrostis filiformis* as a new combination for *Agrostis avenacea* Gmel. but did not do so for Vickery (1941) varieties of this taxon. Vickery (1941) described *Agrostis avenacea* var. *perennis* as "Differs from the type in the perennial rootstock, anthers about 0.7 mm long, culms rather more rigid, about 70 cm high.", based on two specimens from South Australia: Encounter Bay, i.1925, *Cleland H.242* and Wilpena Creek, 10.xi.1928, *Cleland H.238* and two from Victoria: Wando Vale, no date, *Robertson 44* and Yarra, 1853, *Mueller s.n.* Although the culms of the holotype specimen from Encounter Bay are only 1.5 mm wide and the leaves are only 2–2.5 mm wide, spikelet observations e.g. lower glume length 2.7 mm, lemma length 1.7 mm, lemmas covered in 0.5 mm hairs, awn length 4.8 mm and anther length 0.7 mm, conform to measurements made on fresh field collected specimens of *L. perennis*. Additional specimens at AD, with culms 2.5 mm wide and leaves 4 mm wide, from the same general location, collected by J.B. Cleland, during the same period (i.e. Inman River, Encounter Bay, 1.i.1924, *Cleland s.n.*, Inman River, Fleurieu Peninsula, 20.i.1926, *Cleland s.n.*, Inman Valley, Fleurieu Pensinsula, 7.i.1929, *Cleland s.n.*) also conform to *L. perennis*.

Cleland's specimen from Wilpena Creek, seen only from a scanned image, appears to have leaves up to 3 mm wide, culms up to 2 mm wide and panicles and spikelets similar to the holotype of *L. perennis*. Although this specimen represents the most northerly collection of *L. perennis*, other more recent collections from the southern Flinders Ranges (Mt. Remarkable, Wilmington) have been made.

The Wando Vale collection, with its stiff, erect and appressed leaves (to 3 mm wide) and widely spreading panicle, appears to be a mature specimen of *L. aemula*. Measurements of spikelets revealed, lower glume 3.5 mm, lemma 2.0 mm, lemmas covered in 0.8 mm hairs and awn 5.4 mm.

The Yarra specimen, again seen only from a scanned image, appears to have culms about 2 mm wide and leaves to 4 mm wide. But the general appearance of its panicle and spikelets suggest it is probably a robust form of *L. filiformis*.

The recognition of varieties within *L. filiformis* is inhibited by the lack of uniformity in delineation of its diagnostic characters. Veldkamp (1982), after consideration of Vickery's brief description of var. *perennis*, decided that as her diagnostic characters could occur alone or in various combinations, such a variety could not be supported. While Veldkamp (1982) included within *Agrostis avenacea*, leaf widths up to 4.5 mm, spikelets (3.1–)3.25–4(–5.4) mm long, lemmas (1.5–)1.75–2.1(–2.65) and anthers (0.35–)0.4–0.5(–1), most Australian Floras are more restricted in their descriptions of this taxon. For example, Walsh and Entwisle (1994) note leaf width to 3.5 mm, spikelets 2–4.5 mm, lemmas 1.3–2 mm and anthers mostly 0.1–0.5 mm while Jessop and Toelken (1986) record leaf width 2–4 mm, spikelets 2.5–3.5 mm, lemmas nearly 2 mm and anthers 0.2–0.4 mm (except var. *perennis* at 0.7 mm). Veldkamp's descriptions are broad enough to encompass *L. aemula*.

While *Agrostis avenacea* var. *perennis* has been noted in State Floras in the past (Jessop & Toelken 1986; Walsh & Entwisle 1994), it is currently not accepted, even in South Australia (Barker *et al.* 2005). This appears to have been the result of uncertainty over delineation of annual and perennial forms of *L. filiformis*, rather than through use of other diagnostic

Figure 4: *Lachnagrostis leviseta*: **a** mature panicle ×0.25; **b** tussock ×0.1 (*Brown 1645* MEL). *L.* ×*contracta*: **c** immature panicle ×0.25; **d** mature panicle ×0.25 (*Brown 877* MEL). *L. palustris*: **e** mature panicle ×0.25; **f** immature panicle ×0.25 (*Brown 1643* MEL). *L. deflexa*: **g** tussock ×0.25 (*Brown 1722* holotype MEL).

features. This was found to be particularly so at AD, where a wide range of robust specimens, including a number of *L. aemula* collections, had been, at one time or another, determined as *Agrostis avenacea* var. *perennis* but seemingly with no other guide than their large size and appearance of perenniality.

On the other hand, in Victoria, only one specimen at MEL had previously been determined as var. *perennis* (Snowy Creek, Freeburgh, 21.iii.1984, *Scarlett 717* – cultivated from a piece of rhizome) and the robust forms of *L. filiformis* at MEL had not been separated out from typical *L. filiformis*. Although the *Scarlett* specimen conforms to *L. perennis* in terms of spikelet measurements (lower glume 3.0 mm, lemma 1.6 mm, anthers 0.5 mm), its rather long awns (5.6–6.0 mm) and weeping panicle suggests otherwise. During a field visit to the Freeburgh site, I found only a small population of typical, though moderately large, *L. filiformis*.

A further specimen at MEL (Broken River, East Shepparton, 14.xi.1991, *Thomas 474*) prompted another site visit, resulting in collections made from the river bank which are identical to those previously collected (leaves to 6 mm wide, culms to 3 mm wide, lower glumes 2.6–3.0(–3.3) mm, lemmas 1.4–1.7 mm, lemmas covered in 0.5–0.6 mm hairs and anthers 0.6–0.7 mm). In all these respects this population conforms to *L. perennis*, but again, the panicle is large and weeping and differs substantially in this respect. The panicles however, are more open and less crowded when compared to the population collected and measured as part of the *L. filiformis* B group (Shepparton East) (with its smaller anthers and larger spikelets), found growing in an irrigation ditch, only some 500 m away. I have occasionally made other collections of *L. filiformis* with small spikelets (less than 3.5 mm) and moderately large anthers (0.6–0.8 mm long) but the vast majority of *L. filiformis* have anthers less than 0.5 mm and often only 0.2–0.3 mm. Clearly, further work is required to resolve the taxonomic status of the robust forms of *L. filiformis*. At the present time, it appears unlikely that *L. perennis* grows in Victoria but that other as yet unnamed taxa do.

Despite the confusion surrounding this taxon and the work still required on *L. filiformis*, the present study has found sufficient diagnostic differences in *L. perennis* to separate it from the majority of robust *L. filiformis* plants and to raise Vickery's variety to specific status. While some specimens on herbarium sheets may remain difficult to determine because of insufficient material, advanced maturity or distortion following pressing, field observations of *L. perennis* populations leave little doubt as to their distinctiveness from *L. filiformis*. This distinctiveness was strongly supported by the pot study. Plants are always tall with wide and firm to rather stiff leaves and have well exserted, more or less erect, pale to light green panicles (superficially *Phragmites*-like in the early stages of development). While the glumes of typical *L. filiformis* are acuminate, relatively narrow, somewhat thin and have transparent marginal regions, glumes of *L. perennis* are acute, relatively broad, rather firm and opaque to translucent on the laterals.

***Distribution*:** Endemic to South Australia. Growing throughout the Mt. Lofty Ranges and the southern Flinders Ranges and occasionally extending into the western parts of the Murray River Valley through the eastern watershed of the ranges (Fig. 3).

***Ecology*:** Confined to creek lines and on river flats (many of which are now more or less saline, particularly in the more northerly regions).

***Common name*:** Perennial Blown-grass

***Selected specimens examined*: SOUTH AUSTRALIA.** Torrens River, 28.xii.1847, *Mueller s.n.* (MEL); Onkaparinga River, Clarendon, 19.xii.1881, *Tepper 439* (MEL); Upper Braughton River, 1894, *Richards s.n.* (MEL); Inman River, Encounter Bay, 1.i.1924, *Cleland 30B* (AD); Marialta, 20.ix.1924, *Cleland 12A* (AD); Wilpena Creek, 10.xi.1928, *Cleland H.23B* (K); Mt Remarkable National Park, 1.xii.1988, *Canty et al. 25B4* (AD); Tothill Belt, 10.xii.1988, *Bates 16475*; creek by Martindale Stud Homestead, 16.xii.1989, *Bates 21714* (AD); near Eden Valley, 13.i.1990, *Bates 21930* (AD); Kaiserstuhl Conservation Park, 14.i.1990, *Bates 21963* (AD); Mouth of River Marne, 18.iii.1990, *Bates 22725* (AD); Wirrilda via Brukunga, 12.v.1990, *Bates 23031* (AD); Manneside Christian Reserve, Black Hill, 19.xii.1995, *Spooner 156B6* (AD); Mambray Creek, 26.x.1997, *Bates 4B729* (AD); creek at Melrose, 27.xii.1997, *Bates 49402* (AD); Harris Road, Lenswood, 1.i.2000, *Bates 55674* (AD); River Light, Hansborough Bridge, 23.i.2000, *Bates 55B31* (AD); Trura Gorge, 23.i.2000, *Bates 55B34* (AD); near Kapunda, 12.ii.2000, *Bates 55B34* (AD); Mt. Adam area, 27.xii.2000, *Bates 57934* (AD, MEL); Sevenhill Creek, Clare, xi.2001, *Bates 60372* (AD); Hillam Track, Mt Remarkable, 27.xi.2003, *Bates 61B46* (AD, MEL); Greenhood Track, Scott Bottom, Scott Creek Conservation Park, 29.xii.2003 *Brown 1639* (CANB, MEL, HO); Little Para River on Glenburnie Station at One Tree Hill, 30.xii.2003, *Brown 1640*

(NSW, CANB, MEL); Cannon Falls, Spring Creek via Wilmington, xii.2005, *Bates 66930* (MEL) (Figs. 4e-f, 5a-d).

3. *Lachnagrostis palustris* A.J.Br. *sp. nov.*

Gramen caespitosum, perenne, 25–80 cm altum. Culmi geniculati. Vaginae foliorum purpuratae, laminae foliorum involutae. Ramuli panicularum, pedicelli et spiculae primo purpurati, tandem ochracei. Spiculae plerumque 3.4–3.7 mm longae; lemmata dense pilosa, arista plerumque 5–6 mm longa, antherae 0.4–0.6 mm longae.

***Type*: SOUTH AUSTRALIA**. Nangwarry, 3.i.1996, *Bates 41870* (holotype: AD)

Bluish-green to purplish-green, tufted, glabrous, *perennial*, 25–80 cm tall including inflorescences; culms 1–2 mm wide, rigid, sometimes branched, erect but often strongly geniculate at the nodes and pulling away from the leaf sheath which flattens with age; most nodes enclosed or just exserted beyond the leaf sheath, glabrous, strongly purple; sheaths smooth. *Leaf blades* erect, smooth to scaberulous, generally involute when young but flattening with age, 5–15(–20) cm long and 0.2–1.5 mm wide; ligule membranous, acute becoming lacerate, (4–)6–8 mm long. *Inflorescence* an open panicle, 10–35 cm long from the lowest whorl, exserted at maturity with erect, divaricate to spreading, rather stiff, though fine, primary branches to 8 cm long but often less than 5 cm long; branches and pedicels becoming strongly purple soon after emergence but fading with age, scabrous. *Spikelets* (3.2–)3.4–3.7(–4.0) mm long, strong purple but

Figure 5: *Lachnagrostis palustris*: **a** anther ×11; **b** spikelet group ×2.8; **c** floret ×11; **d** spikelet ×11 (*Brown 1645* MEL). *L. leviseta*: **e** spikelet group ×2.8; **f** anther ×11; **g** floret side view ×11; **h** floret back view with occasional long bristle ×11; *i* spikelet ×11 (*Brown 1714* MEL).

fading with age to pale golden brown; glumes acuminate, unequal, the lower 0.2–0.4 mm longer, keels scabrous, lateral surfaces smooth to finely papillose, margins without cilia or with a few scattered cilia; lemma acute, 1.5–1.8 mm long, minutely (0.1–0.3 mm) 4-toothed at the apex or sometimes the lateral nerves extended into short setae (0.5–0.7 mm), covered in 0.3–0.5 mm long hairs, callus with hairs 0.5–0.7 mm long; awn inserted from near the mid-dorsal region of the lemma, (4.3–)5.0–6.0(–6.5) mm long, strongly geniculate, the bristle being 1.5–2.0 times as long as the column; palea 1.2–1.6 mm long; rachilla extension plumose, 1.2–1.6 mm long including hairs; anthers 0.4–0.5(–0.6) mm long.

Notes: In the field, this taxon is readily distinguished from other *Lachnagrostis* by the combination of its involute leaves and its strong purple lower leaf sheaths and emerging inflorescences. Leaves often flatten with ongoing senescence and the purple of the inflorescences and culms fades quickly with age and in pressed specimens. These changes can make it difficult to distinguish this taxon from some of the more erect inflorescence forms of *L. filiformis*. The species generally grows in the central, wettest parts of the swamps it inhabits, along with more typical *L. filiformis*, while *L. aemula*, if present is confined to the edges.

Other, as yet undescribed, '*filiformis*-like' plants with smaller spikelets or longer and more lax inflorescence branches than *L. palustris* but with involute leaves have been found in similar environments to this taxon. Although they may have purple inflorescences, they generally lack the purplish to bluish-green leaves of *L. palustris*. They often display finer leaves and narrower, less rigid and less geniculate culms but some of these features may also be associated with more stunted forms of *L. palustris* and *L. filiformis*. Whether these populations are of one or more entities is still to be ascertained.

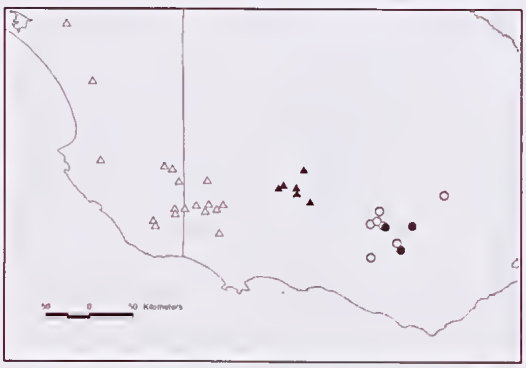

Figure 6: Known distribution of *Lochnagrostis polustris* △, *L. leviseto* ▲, *L. deflexo* ○ and *L. xcontrocto* ● in South Australia and Victoria.

Distribution: Mainly restricted to the central border regions of South Australia and Victoria but with isolated occurrences towards Meningie. Could be more widespread throughout south-east South Australia and south-west Victoria (Fig. 6).

Ecology: Generally confined to fresh-water sedge (including *Eleocharis*, *Lepidosperma* and *Chorizandra* spp.) swamps and marshes but occasionally found growing in moist depressions in Eucalyptus woodlands or on swales.

Etymology: Named for its habitat.

Common name: Marsh Blown-grass

***Other specimens examined*: SOUTH AUSTRALIA.** Big Heath Conservation Park, 4.xi.1969, *Alcock 2933* (AD); Big Heath Conservation Park, 6.xi.1969, *Weber 1838* (AD); Comaum, 1975 (?), *Alcock 58* (AD); Mary Seymour Conservation Park, 14.xi.1989, *Alcock 71* (AD); Caroline State Forest, 4.i.2000, *Bates 55641* (AD); Nangwarry, 15.i.2001, *Botes 58010* (AD, MEL); Penola Conservation Park, 27.xi.2003, *Murfet 4559 and Lowrie* (AD); Nangwarry, 31.xii.2003, *Brown 1641* (CANB, MEL, HO), *1642* (NSW, CANB, MEL); South of Nangwarry, 31.xii.2003, *Brown 1643* (AD, MEL, HO); Penola Conservation Park, Easter 2005, *Botes 64942* (AD); Topperwein Nature Forest Reserve (central waterhole), 16.i.2006, *Botes 67531* (AD, MEL); Topperwein Nature Forest Reserve (northern swamp), 17.i.2006, *Brown 1710* (NSW, CAN8, MEL, HO); Gum Lagoon Conservation Park, 20.xi.2007, *Botes 75798* (MEL); east of Cape Jaffa, 20 ix.2007, *Botes 75890* (MEL); south of Yumali, 18.xii.2007, *Botes 76337* (MEL); The Marshes, Glencoe, 20.xii.2007, *Brown 2089* (MEL); Honans Native Forest Reserve, Glencoe, 20.xii.2007, *Brown 2091* (NSW, CAN8, MEL). **VICTORIA.** Tullich Swamp, 24.xii.1998, *Brown 1533* (NSW, MEL, HO), *1534* (MEL); Heathfield, 31.xii.2003, *Brown 1644* (AD, MEL); Sims Road, Lake Mundi, 17.i.2006, *Brown 1711* (MEL); Heathfield, 18.i.2006, *Brown 1712* (MEL); West of Casterton, 18.i.2008, *Brown 1903* (MEL); Nangeela State Forest, 18.i.2008, *Brown 1910* (MEL); Weecurra State Forest, 18.i.2008, *Brown 1912* (MEL); Roseneath State Forest, Dergholm, 19.ii.2008, *Brown 2041* (MEL).

4. *Lachnagrostis leviseta* A.J.Br. *sp. nov.*

Gramen perenne ad 65 cm altum. Folii involuti. Paniculae erectae, diffusae. Ramuli panicularum et pedicelli et spiculae valde purpurati. Spiculae plerumque 3.5–4.0 mm

longae; lemmata dense pilosa, arista nulla vel minuta (ad 0.3 mm); antherae 0.7–0.9 mm longae.

***Type*: VICTORIA**. Grampians, west side near Henty Highway, 31.1.1975, *Peel* s.n. (holotype: MEL).

Bluish-green, tufted, glabrous, *perennial*, 50–65 cm tall including inflorescences; culms 1–2 mm wide, erect; nodes enclosed or very occasionally just extended beyond the leaf sheath, glabrous, purple; sheaths smooth to very slightly scaberulous, sometimes purplish. *Leaf blades* erect, scaberulous, involute, to 20 cm long but often less than 10 cm and 0.5 mm or less wide; ligule membranous, acute, (3–)5–6 mm long. *Inflorescence* an open panicle 15–25 cm long from the lowest whorl, exserted at maturity with a visible peduncle up to 15 cm long; branches divaricate to spreading, erect, rather stiff, scabrous, strongly purple; pedicels from 3–16 mm long, scabrous, strongly purple. *Spikelets* (3.3–)3.5–4.0 mm long, purple (particularly along the keels); glumes acuminate, unequal, the lower 0.2–0.3 mm longer, keels scabrous, lateral surfaces smooth to slightly scaberulous or papillose, margins without cilia; lemma acute, 1.7–2.1 mm long, entire or minutely (0.1 mm or less) 4-toothed at the apex, covered in 0.5–0.7 mm long hairs, callus with hairs 0.6–1.0 mm long; awn absent or reduced to a minute point or bristle, 0.5 mm or less, inserted from near the apex of the lemma and obscured by the lemma hairs or sometimes occasional lemmas with a fine bristle to 2.5 mm arising from ¾ of the lemma length; palea 1.4–1.7(–2.0) mm long; rachilla extension plumose, (1.5–)1.7–2.0 mm long including hairs; anthers 0.7–0.9 mm long (Fig. 4a–b, 5e–i).

***Notes*:** The involute leaves and minutely awned or awnless lemma of this taxon easily distinguish it from other *Lachnagrostis* species.

Figure 7: *Lachnagrostis* ×*contracta*: **a** anther ×11; **b** spikelet ×11; **c** floret ×11; **d** spikelet group ×2.8 (*Brown 877* MEL). *L. deflexa*: **e** spikelet group ×2.8; **f** anther ×11; **g** floret ×11; **h** spikelet ×11 (*Brown 1722* holotype MEL).

***Distribution*:** Victorian endemic. Restricted to a region adjacent the western edge of the southern Grampians in South-west Victoria (Fig. 6).

***Ecology*:** Confined to saline drainage lines, often in association with *L. adamsonii*.

***Etymology*:** Named for the insignificant awn on the lemma.

Common name: Awnless Blown-grass

***Other specimens examined*: VICTORIA.** Gatum, 22.xii.2003, *Brown 1645* (MEL); Cavendish-Glendinning Road, Glendinning, 31.xii.2004, *Brown 1713* (MEL, HO); Mooralla Demonstration Site, 6.xii.2005 *Brown 1714* (CANB, MEL); Middletons Crossing and Victoria Point Roads Corner, Victoria Valley, 6.xii.2005, *Brown 1715* (AD, NSW, MEL); Mooralla, 17.i.2006, *Brown 1716* (NSW, MEL, HO); Woohlpooer, 17.i.2006, *Brown 1717* (MEL); Glenisla, 18.i.2008, *Brown 1906* (MEL) (Figs 4g, 7e-h).

5. *Lachnagrostis deflexa* A.J.Br. *sp. nov.*

Gramen caespitosum, annuum vel perenne bevivivum, 20–70 cm altum. Culmi ascendentes valde geniculati. Folia plana in vivo, 1.5–3 mm lata. Paniculae valde exsertae, ramuli inferni valde deflexi ubi maturi. Spiculae plerumque 4.5–5.5 mm longae; glumae ad apicem setiformes, seta ad 1.7 mm longa; carinae valde scabrae, marginibus ciliatis; lemmata fere glabra, arista geniculata ad 6.5 mm longa, medifixa in carina lemmatis; antherae plerumque 0.5–0.7 mm longae.

***Type*: VICTORIA**. Lake Bolac, 17.i.2006, *Brown 1722* (holotype: MEL; isotypes: AD, NSW, HO).

Mid to light green, tufted, glabrous, *annual or short-lived perennial*, 20–70 cm tall including inflorescences but often less than 40 cm; culms 1.0–1.5 mm wide, ascending or occasionally erect, often strongly geniculate; nodes enclosed or occasionally extended beyond the leaf sheaths, glabrous, pale brown; sheaths smooth, often noticeably inflated. *Leaf blades* erect to spreading, scaberulous, flat but becoming inrolled on drying, to 12 cm long but often less than 5 cm, 1.5–3 mm wide when flat; ligule membranous, acute becoming lacerate, abaxial surface densely and finely scaberulous, (5–)7–9 mm long. *Inflorescence* an open panicle 10–20 cm long from the lowest whorl, exserted at maturity with a visible peduncle subequal to the panicle length; panicle often only half as wide with stiff, erect to spreading branches above and strongly deflexed branches below at maturity; secondary branches only slightly divergent or appressed to primary branches; branches and pedicels green or sometimes with a purplish cast, scabrous; pedicels 1–5 mm long. *Spikelets* (4.0–)4.5–5.5 mm long including glume setae, green or sometimes purplish-green; glumes acuminate, (3.0–)3.3–4.0 mm long, subequal or the lower longer by up to 0.3 mm, the central nerve of each glume extended to a fine seta 1.0–1.7 mm long, keels strongly scabrous, lateral surfaces finely scaberulous, margins ciliate; lemma acute, 2.2–2.7(–3.0) mm long with the nerves extended into short setae 0.3–0.7 mm long, glabrous except for a few occasional hairs towards the margins, callus with hairs 0.5–0.6 mm long; awn inserted from near the mid-back of the lemma, geniculate, 4.5–6.5 mm long with the bristle about 2.5–3.5 times longer than the column; palea 1.9–2.2 mm long, minutely bifid; rachilla extension plumose, 1.5–2.0 mm long including hairs; anthers 0.5–0.7(–0.8) mm long.

***Notes*:** Bentham (1878) described var. *aristata* for *Deyeuxia forsteri* (Roem. & Schult.) Kunth *nom. illeg.* (syn. *Agrostis avenacea* J.F.Gmel., *Lachnagrostis filiformis*) as having long points on the outer glumes. Vickery (1941) considered that the specimens cited by Bentham (from the Swan and Murchison Rivers, Western Australia) were scarcely different from the typical species he described and as a consequence, did not accept this variety. In Victoria, I have occasionally found specimens of *L. filiformis* with glume setae up to about 1 mm in length but the spikelets are always smaller than in *L. deflexa*; the overall length of the lower glume (including the seta) never exceeding about 4 mm. This appears to be the same for Western Australian specimens. Unlike *L. deflexa*, mature panicles of *L. filiformis* are generally as broad as they are long and, although it can display branch deflexion, it is normally restricted to an occasional branch of the lowest whorl.

Observations of the narrow, disarticulated mature panicles of *L. deflexa* show that they fall and lodge largely in or near the mother plant and are not picked up and carried by the wind. In addition, unlike *L. filiformis*, spikelets appear to readily shed their florets as soon as they start to senesce. These characteristics may explain why this species has a limited distribution. However, it is also probable that the species has been overlooked to some extent, being merely regarded as part of the *L. filiformis* populations with which they share their habitat.

***Distribution*:** Endemic to Victoria. Restricted to the central parts of South-west Victoria (Fig. 6).

***Ecology*:** Confined to saline or brackish flats, swamps and lake verges.

***Etymology*:** Named for the strongly deflexed branches of the panicle.

Common name: Deflexed Blown-grass

***Other specimens examined*: VICTORIA.** Mininera East, 11.i.1994, *Brown 874* (MEL), *875* (NSW, CANB, MEL, HO), *876* (NSW, MEL, HO); Streatham, 11.i.1994, *Brown 871* (AD, NSW, CANB, MEL, HO); Streatham, vi.1994, *Brown 994* (AD, MEL, HO), *995, 996, 997* (MEL); Lake Bolac, 31.xii.2003, *Brown 1718* (NSW, CANB, MEL); Chinamans Swamp, Westmere, 26.iii.2004, *Brown 1719* (MEL); Chinamans Swamp, Westmere 16.iii.2005 *Brown 1720* (MEL, HO); Deep Lake, Derrinallum, 18.i.2006, *Brown 1723* (NSW, MEL); Lake Burrumbeet, 6.xii.2007, *Brown 214B* (MEL, HO); Lake Bookar 17.i.2008, *Brown 1891* (MEL).

6. *Lachnagrostis* ×*contracta* A.J.Br. *nothosp. nov.*

Apparenter hybrida inter L. deflexa et L. adamsonii. Gramen sterile hybridum ad 90 cm altum. Folia plana in vivo, plerumque 2–3 mm lata. Paniculae subdiffusae, ramuli primarii leniter divergentes, ramuli secundi et tertiarii appressi. Spiculae plerumque 4.0–4.5 mm longae; glumae ad apicem setiformes, seta ad 1.6 mm longa; carinae valde scabrae, marginibus ciliatis; lemmata glabra, arista ad 4 mm longa, inserta circa □ e basi lemmatis; antherae sterile, 0.5–0.8 mm longae; flosculus saepe fungo infectus.

***Type*: VICTORIA**. Skipton, 16.xii.1996, *Brown 1222* (holotype: MEL; isotypes: AD, CANB).

Mid green, tufted to shortly rhizomatous, glabrous, *annual* or *short-lived perennial*, 45–90 cm tall including inflorescences; culms 1.5–3 mm wide, ascending to erect; nodes enclosed by leaf sheaths, sheaths smooth. *Leaf blades* erect, scaberulous, flat becoming inrolled on drying, to 25 cm long or flag leaves to 10 cm, 2–3(–4) mm wide when flat; ligule membranous, acute becoming lacerate, 5–7 mm long. *Inflorescence* a contracted to semi-open panicle 10–20 cm long from the lowest whorl, exserted at maturity with a visible peduncle up to 10 cm long or more; primary branches stiff, erect to slightly divergent; secondary and tertiary branches strongly appressed and crowded; branches and pedicels green or purplish, scabrous; pedicels 1–3(–4) mm long. *Spikelets* (3.5–)4.0–4.5(–5.5) mm long including glume setae, green or purplish-green; glumes acuminate, 3.0–4.0 mm long, subequal or either glume up to 0.5 mm or more longer than the other, the central nerve of each glume extended into a fine seta 0.6–1.6 mm long, keels strongly scabrous, lateral surfaces finely scaberulous, margins ciliate; lemma acute, 2.0–2.5 mm long, entire or minutely (0.1–0.2 mm) 4-toothed at the apex, glabrous or with a very occasional hair towards the margins, callus with hairs 0.3–0.4 mm long; awn reduced to a straight or curved bristle (2.2–)2.5–4.0(–4.8) mm long, inserted about ½ of the lemma length; palea 1.8–2.1 mm long; rachilla extension plumose, 0.7–1.4 mm long including hairs; anthers 0.5–0.8 mm long, pollenless; seed undeveloped or replaced with an engorged receptacle of smut (ergot) (Fig. 4c–d, 7a–d).

***Notes*:** The parentage of this entity is unknown but is expected to include *L. deflexa* given its similar distribution (growing in association on at least one site), growth habit and similarities in some spikelet and floret characteristics. The other parent is likely to be *L. adamsonii* which also has a reduced awn and has been found growing at all currently known locations of *L.* ×*contracta*.

On first appearance, the inflorescence is similar to that of *Agrostis stolonifera* L. or an immature *A. capillaris* L.

***Distribution*:** Endemic to Victoria. Restricted to the central parts of South-west Victoria (Fig. 6).

***Ecology*:** Confined to saline swamps.

***Etymology*:** Named for the contracted habit of the panicle.

Common name: Contracted Blown-grass

***Other specimens examined*: VICTORIA.** Streatham, 11.i.1994, *Brown 877* (AD, MEL), *878* (MEL, HO); Derrinallum, 21.xii.2005, *Brown 1721* (NSW, MEL, HO).

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Correa alba Andrews var. *rotundifolia* DC. (Rutaceae): an old name for a newly recognised variety endemic to south-eastern Tasmania

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Introduction

Correa alba Andrews (Rutaceae), though easily identifiable, has had a complicated taxonomic history. The genus and species were first described by Andrews (1798) from material that was grown from seed collected by Sir Joseph Banks from Port Jackson [Sydney] (Table 1). Soon after this Salisbury (1808) indicated that he had never seen plants with petals that were entirely white and so thought the specific epithet, *alba*, was inappropriate. He erected the new name *C. cotinifolia Salisb.* which, as *C. alba* is given in synonymy under var. α, is illegitimate. Labillardiere (1800) described *Mazeutoxeron* Labill. and *M. rufum* Labill. from material he collected in south-eastern Tasmania in 1793 (Table 1). Ventenat (1803) transferred this species to the genus *Correa* Andrews and later, Candolle (1824) published it as a variety of *C. alba*: *C. alba* var. *rotundifolia* DC. The epithet *'rotundifolia'* was again used by Lindley (1838) when he described *C. rotundifolia* Lindl. This taxon was based on material collected from Glenelg River [western Victoria] by T.L. Mitchell in 1836. Bentham (1863) reduced this species to a variety of *C. alba*, *Correa alba* var. *rotundifolia* (Lindl.) Benth., an illegitimate combination as it is a later homonym of *C. alba* var. *rotundifolia* DC. (Table 1). Wilson (1961) determined that the taxon described by Lindley warranted taxonomic recognition and so created the new name *C. alba* var. *pannosa* Paul G.Wilson based on *C. rotundifolia*.

Correa alba is found in near-coastal areas from Kangaroo Island [requires confirmation – see *Distribution* under var. *pannosa*] and the Southern Lofty Region (South Australia) through southern Victoria and to the North Coast of New South Wales. It is also found on the islands of the eastern side of Bass Strait and has a patchy distribution on the northern and eastern coasts, and nearby islands, of the island of Tasmania. Currently two varieties are recognised (see Wilson 1961,

Abstract

The name *Correa alba* Andrews var. *rotundifolia* DC. (Rutaceae) is resurrected for a newly recognised variety endemic to south-eastern Tasmania. *Mazeutoxeron rufum* Labill., the basionym, is lectotypified. A key to the three varieties of *C. alba* is provided as are descriptions and notes.

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1998; Anderson 1986; Duretto 1999; Anonymous 2001; Weston & Harden 2002; Ross & Walsh 2003; Walsh & Stajsic 2007). *Correa alba* var. *alba* is found in New South Wales, eastern Victoria and Tasmania. *Correa alba* var. *pannosa* is found in western Victoria and south-eastern South Australia.

Correa alba var. *alba* shows some variation which was noted by Wilson (1961) who noted that plants in the north had leaves that were 'thinly tomentose below' while plants from further south had leaves that were 'thickly ferruginous tomentose' (see Fig. 1). Typical var. *alba* is found on the East Coast of Tasmania north from Triabunna and across northern Tasmania, on the islands of eastern Bass Strait through eastern Victoria and in coastal New South Wales. The abaxial surface of the leaves has a dense indumentum of stellate hairs that are mostly sessile (Fig. 1A-D). A form from south-eastern Tasmania, the Tasman and Forestier peninsulas, the South Arm area (near Hobart) and Bruny Island, is easily distinguishable in that it has large hairs that are stalked (Fig. 1I-L). There is a 50 km wide gap, between Dunalley and Triabunna, separating the two forms. This second form from the south-east of Tasmania, with the stalked hairs, matches the type material of *Mazeutoxeron rufum* and so the name *C. alba* var. *rotundifolia* DC. can be applied to it (see *Typification* under this variety). *Correa alba* var. *rotundifolia* is similar in appearance to *C. alba* var. *pannosa* as both have large stalked hairs (Fig. 1E-L), but the stalks and rays of the hairs are shorter in var. *rotundifolia*. Also the stalks of the hairs of *C. alba* var. *pannosa* often have a large number of rays along their length, whereas they are smooth and rayless except at the tip in var. *rotundifolia* (see key to varieties below).

Materials and methods

Research was carried out on both herbarium specimens and on material collected in the field. Herbarium material (c. 200 specimens) from the Tasmanian Herbarium (HO), the National Herbarium of Victoria (MEL) and the National Herbarium of Australia (CANB) was studied. This covered the full geographical distribution of *C. alba*. Plant collections of *C. alba* were made in south-eastern Tasmania, in the South Arm area (two populations) and the Tasman Peninsula (three populations). Specimens from three to five widely spaced plants were collected from each population sampled. Specimens have been lodged at the Tasmanian Herbarium. The typical form of *C. alba* var. *alba* was observed in the field by BKC at Swansea, Oyster Bay, Freycinet Peninsula (Tas.) and Jervis Bay (ACT).

For Scanning Electron Microscopy (SEM), leaves of selected specimens were mounted on aluminium stubs using double-sided or carbon tape with carbon paint. Specimens were then coated with platinum using a JFC–1100E ion sputtering device, and examined and photographed at 7kV and 10kV using HITACHI S–4700.

Terminology for describing the hairs is complex and not fully covered in e.g. Hewson (1988). In *C. alba* var. *pannosa* and var. *rotundifolia* the stellate hairs are stalked. In the latter the stalk is usually smooth (i.e. lacking outgrowths) and terminates in a tuft of multidirectional rays. In var. *pannosa* the stalk often has a number of simple rays (similar to those of the terminal tuft) emerging from it. These simple rays are often clustered and so the hair often looks like two to four stalked stellate hairs placed on top of each other. As such it would be misleading to call the hair dendritic (branched like a tree) or branched (see Fig. 1).

Table 1: Namenclatarial history *af Carrea alba*

Name	Date	Basionym	Accepted name
***Carrea alba* Andrews**	1798		*C. alba*
***C. catinifalia* Salisb.**	1808	*C. alba* Andrews	*C. alba*
***Mazeutaxeran rufum* Labill.**	1800		*C. alba* var. *ratundifalia* DC.
***C. rufa* (Labill.) Vent.**	1803	*M. rufum* Labill.	*C. alba* var. *ratundifalia* DC.
***C. alba* var. *ratundifalia* DC.**	1824	*M. rufum* Labill.	*C. alba* var. *ratundifalia* DC.
***C. ratundifalia* Lindl.**	1838		*C. alba* var. *pannasa*
***C. alba* var. *ratundifalia* (Lindl.) Benth.**	1863	*C. ratundifalia* Lindl.	*C. alba* var. *pannasa*
***C. alba* var. *pannasa* Paul G.Wilsan**	1961	*C. ratundifalia* Lindl.	*C. alba* var. *pannasa*

Taxonomy

Correa alba **Andrews, *Bot. Repos*. 1: t.18 (1798)**

Correa cotinifolia Salisb., *Parad. Lond.* t. 100 (1808), *nom. illeg.*, based on above.

***Type*: NEW SOUTH WALES**. Port Jackson, raised in 1793 from seeds given by J. Banks to J. Vere (holotype [see Wilson 1961, p. 38]: *Bot. Repos.* 1: t. 18).

Rounded, spreading, multi-stemmed, woody *shrub* to 3 m high, to 4 m in diameter, large plants often supported by other vegetation; stems stellate tomentose, glabrescent with age; stellate hairs white to red-brown. *Leaves* simple, petiolate; petiole 2–8 mm long; lamina elliptic to obovate to orbicular, rarely ovate or lanceolate or oblanceolate, 5–46 mm long, 2.5–28.5 mm wide, discolorous; tip acute to obtuse; margins entire; adaxial surface greyish green, with a sparse to moderately dense indumentum of stellate hairs that are often eventually deciduous; abaxial surface densely white or greenish white or reddish brown, stellate tomentose. *Flowers* axillary, often solitary though up to 5 flowers per inflorescence not uncommon and then usually one flower opening at a time; peduncles to 9 mm long; bracts leaf-like; bracteoles minute; pedicels 0.5–6.5 mm. *Calyx* cuplike, 2.5–7 mm long, truncate to slightly dentate to dentate or broadly lobed. *Petals* partially fused in bud, free at anthesis, white or rarely pink, 7–17 mm long, 1.5–5 mm wide, adaxial surface glabrous, abaxial surface sparsely to densely stellate tomentose, stellate hairs with rays 0.3–1.8 mm long. *Cocci* hairy, 4–7 mm long, 3–5 mm wide.

Distribution: *Correa alba* is found in near coastal areas from Kangaroo Island [requires confirmation – see *Distribution* under var. *pannosa*] and the Southern Lofty Region (South Australia) through southern Victoria and to the North Coast of New South Wales. In Tasmania it is found on the islands on the eastern side of Bass Strait and has a patchy distribution on the northern and eastern coasts of the Tasmanian mainland and offshore islands. It is apparently absent from King Island.

Habitat: The species occurs in near coastal situations on foredunes, cliffs and headlands. It is found growing on both calcareous and siliceous substrates (sand and/or rock) in heath or woodland.

Notes: *Correa alba* readily hybridises with other species of *Correa* (see Wilson 1961; Anderson 1986; Duretto 1999).

Infraspecific variation: Three varieties are recognised for the species. The rank of variety is appropriate (as opposed to subspecies and species) as the distinctions between the taxa are based on few characters, and these mostly pertaining to hairs, and some problematic specimens do exist (see *Notes* under var. *pannosa*).

Conservation status: Overall the species appears to be secure with the typical variety secure and the other two being rare but found in reserves (see below). *Correa alba* is used extensively in horticultural and revegetation plantings. In Hobart, the two Tasmanian varieties (var. *alba* and var. *rotundifolia*) are both available and commonly used, sometimes in mixed plantings, even though var. *alba* is not indigenous to the area. Care should be taken to use only locally sourced material for any revegetation or coastal planting programs to avoid polluting local gene pools.

Key to varieties of *Correa alba*

1	Stellate hairs on abaxial surface of leaves not stalked or occasionally stalked; stalks, when present, to 0.05 mm long (NSW, Vic., Tas.) ..... **1. *var. alba***
1:	Stellate hairs on abaxial surface of leaves stalked; stalks to 2 mm long (SA, Vic., Tas.) **2**
2	Indumentum of branches and sometimes the abaxial surface of the leaves and calyx uneven and appearing floccose; stalks of stellate hairs long, with some at least 0.75–2.0 mm long, many with rays emerging below the terminal tuft of rays, especially on branches; rays of at least some of the hairs 0.5–1.0 mm long (SA, Vic.) ..... **2. *var. pannosa***
2:	Indumentum of the branches and the abaxial surface of the leaves and calyx smooth and even; stalks of stellate hairs to 0.5 (–0.75) mm long, mostly smooth, viz. without rays emerging below terminal tuft; rays to 0.5(–0.75) mm long (Tas.) ..... **3. *var. rotundifolia***

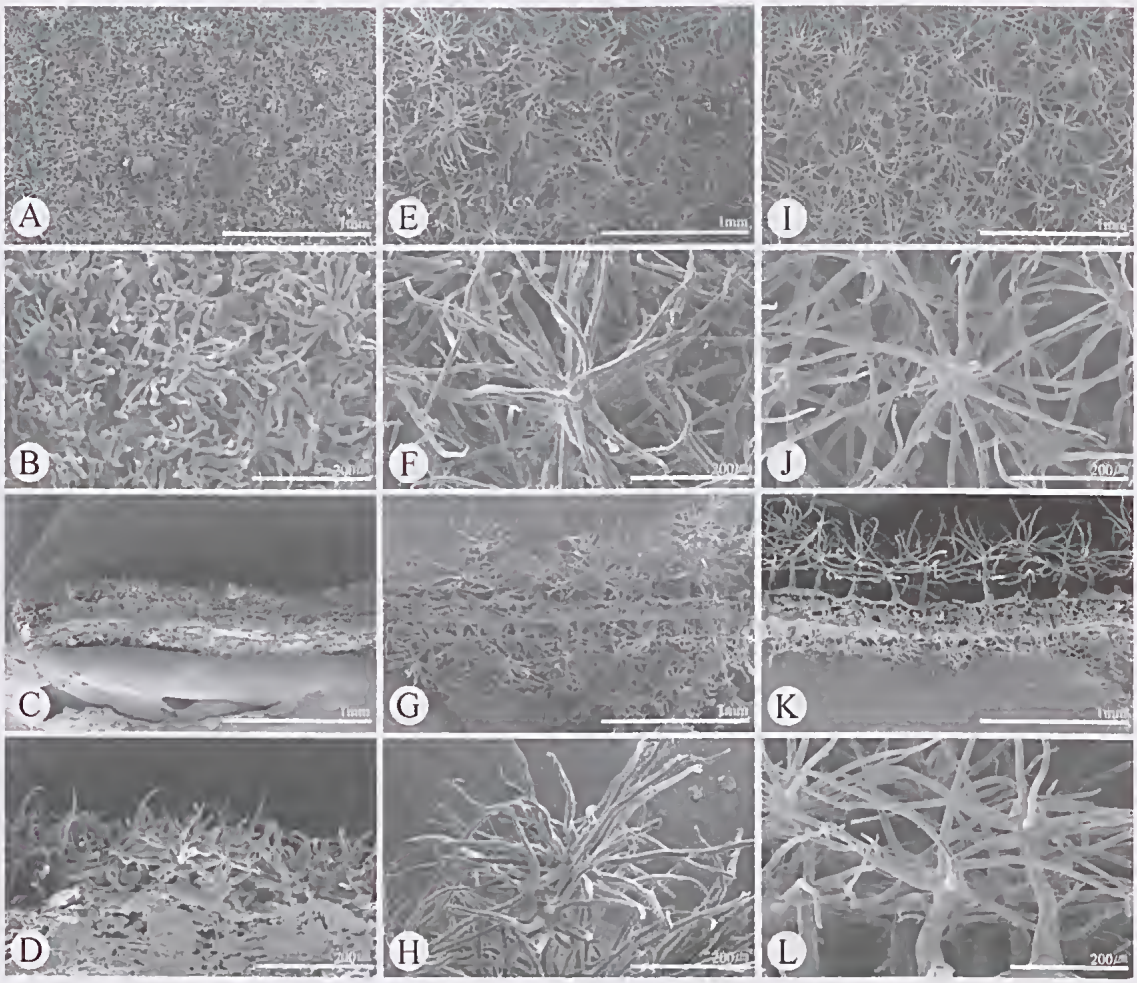

Figure 1. Leaf hairs of *Correo olbo*: A–D, *C. olbo* var. *olbo* (*Duretto 2070 et al.*, HO); E–H, *C. olbo* var. *ponnoso* (*Whibley 10166*, HO); I–L, *C. olbo* var. *rotundifolio* (*Choi 22 & Duretto*, HO). A, 8, E, F, I, J – abaxial surface; C, G, K – cross section with abaxial surface on top; D, H, L – cross section with detail of hair on abaxial surface. A, C, E, G, I, K – x50; 8, D, F, H, J, L – x200.

1. *Correa alba* Andrews var. *alba*

Shrub to 1.5 (NSW, Vic.) and 3 (Tas.) m high; *stems* and *leaves* stellate tomentose (Fig. 1A-D), indumentum smooth in appearance, stellate hairs usually white, sometimes red-brown, mostly sessile, or sometimes with stalks to 0.05 mm long and without rays below terminal tuft, rays 0.1–0.25(–0.5) mm long. *Leaves* with petioles 2.5–7 mm long; lamina 7–46 mm long, 4.5–28.5 mm wide. *Peduncles* 1–6.5 mm long; pedicels 1.25–6.5 mm. *Calyx* 3.25–7 mm long. *Petals* 8.5–17 mm long, 1.5–4.5 mm wide.

Selected specimens (of c. 170 examined): **AUSTRALIAN CAPITAL TERRITORY**. Cave Beach, Jervis Bay, 35°00'S 150°42'E, *F.W.Howes* 27, 13.viii.1980 (CANB). **NEW SOUTH WALES**. North Entrance Peninsula, Tuggerah Beach, 33°18'S 151°32'E, *W.Bishop, J.Dolby & T.Jomes* 812, 22.viii.1985 (CANB); La Perouse, 33°59'30"S 151°14'E, *R. Coveny 11249 & M.Toylor*, 30.viii.1982 (CANB); Jemisons Beach, 500 m S of Potato Point, 36°06'30"S 150°08'15"E, *J.Liney s.n.*, 12.viii.1993 (CANB); Wallaga Lake, Haywards Beach, Tilba road, 36°24'20"S 150°03'50"E, *N.Schultz 103*, 23.iv.1994 (CANB, MEL). **VICTORIA**. Quarry Beach, c. 7 km SW of Mallacoota, 37°36'S 149°44'E, *P.C.Jobson 3517*, 15.iv.1995 (CANB, MEL); Tidal River, Wilson's Promontory, *I.Hostings*, 12.viii.1971 (MEL); Blairgowrie, track leading from Spray Point Road through Ocean Reserve to Bass Strait, Mornington Peninsula, 38°22'S 144°46'E, *J.H.Ross 2533*, 4.iv.1981 (HO, MEL). **TASMANIA**. Craggy Island (15km NW of Flinders Island), 39°41'S 147°41'E, *S.Horris*, 7.xii.1986 (HO); Sentinel Island, 39°49'S 147°46'E, *J.S.Whinroy 8987* (AD, CANB, HO); Coastal dune E of the south eastern corner of East River,

Flinders Island, 40°7'S 148°13'E, *J.S.Whinray 8246* (NSW, CAN8, AD, HO); Kangaraa Island, 40°41'S 144°49'E, *A.M.Buchanan 9115*, 28.xii.1986 (HO); Turners beach, Ulverstane, 41°10'S 146°14'E, *L.Richley* 268, 28.vi.1976 (HO); E Rocky Cape, 40°51'S 145°30'E, *M.Allan*, 22.iii.1979 (HO); 8aat Harbaur, 40°57'S 145°38'E, *J.H.Hemsley 6160*, 21.iv.1967 (HO); Eddystane Paint, 40°59'S 148°21'E, *A.C.Razefelds 445*, 21.i.1997 (HO); Raund Hill Point near Jeanneret 8each, 41°14'S 148°17'E, *M.F.Duretta 2070* et al., 4.i.2006 (HO, MEL); 8ichena, The Gulch, 41°52'S 148°18'E, *A.Mascal 6227*, 12.ii.1984 (HO); Friendly Paint, 42°3'S 148°18'E, *A.M.Buchanan 7161*, 9.ix.1985 (HO); Sleepy 8ay, Freycinet N.P., 42°08'S 148°20'E, *F.E.Davies 1256 et al.*, 25.i.1989 (CANB, HO, MEL); Mareys Bay hut, Schouten Island, 42°18'S 148°16'E, *M.F.Duretta* 1501, 28.ii.2002 (HO); Grindstane 8each, S end, 42°26'S 147°59'E, *A.M.Gray* 1745, 13.xi.2006 (AD, HO, MEL).

Distribution: *Correa alba* var. *alba* ranges from the North Coast of New South Wales, through eastern Victoria to Port Phillip Bay. In Tasmania it is found on the islands of eastern Bass Strait, and on the Tasmanian mainland, and some off shore islands, in the north and south on the East Coast to just north of Triabunna (Fig. 2).

A specimen of var. *alba* purportedly from Louisa Island [*G.White*, HO 29699] off the southern end of Tasmania, is far removed from other collections of this variety. The only other collections of *C. alba* from the South-West botanical region of Tasmania are of var. *rotundifolia* from Bruny Island and maybe South Cape (see below). Curiously the specimen is a perfect match for (leaf colour etc.) and of the same vintage as a herbarium specimen collected from Ulverston (*Richley 268*) in the State's north. The collection details of the specimen form Louisa Island are in doubt and require confirmation.

Figure 2. Distributian *af Carrea alba* var. *alba* in Tasmania, based *an* herbarium specimens.

Phenology: Flowering material has been collected all year but mainly from February to September; fruiting material has been collected from November to January.

Notes: *Correa alba* var. *alba* may intergrade with *C. alba* var. *pannosa* between Port Phillip Bay and around Cape Otway (Victoria) (see Duretto 1999; and *Notes* under var. *pannosa*). Specimens of var. *alba* from Freycinet Peninsula and surrounding islands sometimes have a large number of stalked hairs overtopping a layer of sessile hairs (e.g. *Davies 1256*) and approach var. *rotundifolia* in appearance but do not appear to be part of a cline.

Conservation Status: The variety is widespread, found in several reserves in each of the States it is found in, and so, appears to be secure.

2. *Correa alba* var. *pannosa* Paul G.Wilson, *Trans. Roy. Soc. South Australia* 85: 40 (1961) Fig. 1E-H.

Correa rotundifolia Lindl. in T.L.Mitchell, *Three Exped. Australia* 2:217 (1838); *C. alba* var. *rotundifolia* (Lindl.) Benth., *Fl. Austral.* 1:354 (1863), *nom illeg.* non DC. (1824).

Type: **VICTORIA**. Near mouth of Glenelg River, 15.viii.1836, *T.L. Mitchell 287* (holotype: CGE [*fide* Wilson 1961, 1998]; isotype: MEL 516687).

Shrub to 1 m high; indumentum of stems and leaves densely stellate tomentose (Fig. 1E-H), white to red-brown, uneven and floccose in appearance, often eventually deciduous leaving stalks; stellate hairs usually stalked, stalks to 2 mm long and often with clustered rays emerging along the length below the terminal tuft, all rays (0.25–)0.5–0.75(–1.0) mm long. *Leaves* with petioles 2–4.5 mm long; lamina 5.5–15.5(–20 Cape Otway area) mm long, 4.5–13 mm wide, indumentum often with two hair sizes, larger hairs with usually red-brown rays to 0.75 (–1.0) mm long, smaller

hairs with usually white rays to 0.5 mm long. *Peduncles* to 3.5 mm long; pedicels 0.5–2 mm long. *Calyx* 2.5–3.5 mm long. *Petals* 7–10 mm long.

Selected specimens seen (of 23): **SOUTH AUSTRALIA.** Between Kingston and Salt Creek, 36°36'S 139°51'E, *Hj.Eichler 17785*, 15.ix.1963 (CANB); between Parsons and Waitpinga beaches (11km SW of Victor Harbor), Fleurieu Peninsula, 35°33'5 138°37'E, *R.Schodde 616*, 27.i.1958 (AD, CANB, HO); Newland Head, 35°39'S 138°31'E, *D.J.E.Whibley 10166*, 28.v.1986 (CANB, HO); Glenelg River, between Dry Creek and Donovan's Landing, *D.N.Kraehenbuehl 954*, B.x.1963 (MEL). **VICTORIA.** Lower Glenelg NP, cliff top walk W of end of North Nelson Road, 37°59'S 141°1'E, *M.F.Duretto 1520*, 1.x.2002 (HO, MEL); along a scenic drive at Cape Nelson, *J.C.Anwoy 447*, 24.xi.1965 (MEL); Bats Ridge, c. 12 km W of Portland, *J.H.Seebeck*, 15.v.1972 (MEL); Above Shelly Beach, Bridgewater Bay, 38°22'S 141°25'E, *K.L.Wilson 1169 & L.Johnson*, 18.ii.1975 (MEL, NSW).

Distribution: *C. alba* var. *pannosa* is patchily distributed from Kangaroo Island and Southern Lofty Region (South Australia), along the coast to the Cape Otway area (Victoria). The presence on Kangaroo Island (see Anonymous 2001) requires confirmation.

Phenology: Flowering material has been collected from January to October while fruiting material has been collected from July to October.

Notes: Specimens from Port Campbell to Apollo Bay have larger leaves and sepals than plants in western Victoria and South Australia. They also have smaller hairs and leaves that are more obovate (verses mostly oblanceolate). These specimens have been treated as intermediates between var. *alba* and var. *pannosa* (e.g. past determinations) and superficially are similar to var. *rotundifolia*. With typical var. *pannosa* they share the large hairs with rays along the length of the stalk and are treated here as part of that variety. In addition to the forms outlined above, *C. alba* var. *pannosa* and var. *alba* appear to intergrade between Port Phillip Bay and the Cape Otway area (see Duretto 1999). Further detailed field and laboratory studies are required to determine if these plants are indeed intermediates or warrant taxonomic recognition.

Conservation Status: *Correa alba* var. *pannosa* is considered to be rare both in Victoria (Ross & Walsh 2003; Walsh & Stajsic 2007) and South Australia (Anonymous 2001).

3. *Correa alba* var. *rotundifolia* DC., *Prod.* 1: 719 (1824)

Mazeutoxeron rufum Labill., *Voy. Rech. Perouse* 2: 12 (1800), *Atlas* t. 17 (1800); *Correa rufa* (Labill.) Vent., *Jard. Malm.* 1: sub. t. 13 (1803). Type citation: cap méridional [South Cape], Tas., Feb. 1793, *J.J.H. de Labillardiere.*

***Type*: NEW HOLLAND.** *J.J.H. de Labillardiere* (lectotype here designated: FI [ex Herb. Labillardiere, Herb. Webbianum 32375], images CANB, HO). (Fig. 3)

Shrub to 3 m high, to 4 m wide; indumentum of stems and leaves stellate tomentose (Fig. 1I-L), rough and uneven in appearance, most hairs red-brown, stellate hairs mostly stalked, stalks 0.1–0.5(–0.75) mm and without rays along length, rays 0.2–0.5(–0.75) mm long. *Leaves* with petioles 3–8 mm long; lamina 5–28 mm long, 2.5–27 mm wide. *Peduncle* 1–9 mm; pedicel 0.75–3 mm. *Calyx* 3–6 mm long. *Petals* 8–14 mm long.

Selected specimens (c. 55 specimens examined): **TASMANIA.** Cape Frederick Hendrick, Forestier Peninsula, 42°52'S 147°5B'E, *P.Collier 2577*, 23.viii.19B7 (HO); Dunalley Beach, N end, 42°54'S 147°48'E, *B.Choi 10–16 & M.F.Duretto*, 12.viii.2006 (BKC10, 15 & 16 – HO; BKC11 – HO, KHUS; BKC12 – HO, NSW; BKC13 – HO, MEL; BKC14 – HO, K); Below Tessellated Pavement, 43°00'S 147°55'E, *M.Wopstra*, 19.ix.2006 (HO, MEL); Droughty Point, 42°56'E 147°25'E, *A.M.Buchonon 3243*, B.iv.1984 (HO); Pirates Bay, Tasman Peninsula, 43°2'S 147°56'E, *B.Choi 17–19 & M.F.Duretto*, 12.viii.2006 (BKC17 – HO, PRE; BKC1B – CHR, HO; BKC19 – HO, NE); Lime Bay Nature Reserve, 42°59'S 147°40'E, *P.Collier 1520*, B.viii.19B6 (HO); NW of Pedition Ponds, Cape Pillar, 43°13'S 147°5B'E, *A.M.Buchonon 3294*, 15.iv.19B4 (HO); Tasman Island, 43°14'5 14B°0'E, *R.P.Minchin*, 1.iv.1993 (HO); Opossum Bay, South Arm, 42°59'S 147°24'E, *A.M.Olsen*, 14.iii.1957 (HO); Calverts Beach, E end, 43°1'S 147°29'E, *B.Choi 1–3 & M.F.Duretto*, 11.viii.2006 (BKC1 – HO, MEL; BKC2 – AD, HO; BKC3 – HO, NSW); Lookout near Goat Bluff, near W end of Calverts Beach, 43°1'S 147°2B'E, *B.Choi 4–9 & M.F.Duretto*, 11.viii.2006 (BKC4 – H, HO; BKC5, 6 & B – HO; BKC7 – HO, MEL; BKC9 – AD, HO); Betsey Island, 43°3'S 147°29'E, *K.Horris*, 15.x.1983 (HO); White Beach, Tasman Peninsula, 43°7'S 147°43'E, *B.Choi 20–24 & M.F.Duretto*, 12.viii.2006 (BKC20 – DNA, HO; BKC21 – HO; BKC22 – HO, KHUS, KRA; BKC23 – HO, MO; BKC24 – CANB, HO); Wedge Island, 43°B'S 147°40'E, *F.Duncan*, 6.viii.19B6 (HO); North Bruny Island, The Neck, far NE end, at Mars Bluff, 43°14'S 147°24'E, *J.D.Briggs 1499*, 22.iv.1984 (CANB, HO, MEL); Grass Point, South Bruny Island, 43°21'S 147°21'E, *A.M.Buchanon B375*, 30.iii.19B6 (HO); Southerly Bight, Labillardiere Peninsula, South Bruny Island, 43°25'5 147°5'E, *A.M.Buchonon 421B*, B.xi.1984 (HO).

Figure 3. Lectotype of *Mazeutoxeron rufum* Labill. (FI) = *Correa alba* var. *rotundifolia DC.*

Typification: The specimen of *Mazeutoxeron rufum* illustrated by Labillardiere (1800, plate 17) is difficult to determine on leaf characters alone but the flowers do have unfused petals that reflex back which agrees with Labillardiere's description "Quatre petals sont attachés au fond du calice' as noted by Wilson (1998). As *C. alba* is the only species in the genus with these features the taxon can quite confidently be identified as *C. alba*. Wilson (1998) indicated that the type material of *M. rufum* appeared to be largely vegetative and appears to be a mixture of both *C. alba* and *C. backhouseana* Hook. Colour photographs of the material at the University Herbarium in Florence (FI) have been studied and there are collections made by Labilliardiere of both species. There is one collection of *C. alba* amongst these specimens (Fig. 3) and this specimen (Herb. Webbianum 032375) matches the form found in south-eastern Tasmania; this specimen is chosen as the lectotype following Art. 9.12 of the International Code of Botanical Nomenclature (McNeill et al. 2006).

Labillardiere (1800) indicated the material of *M. rufum* came from South Cape where he camped and collected. *Correa alba* has not been collected again from this area though *C. backhouseana* is common there.

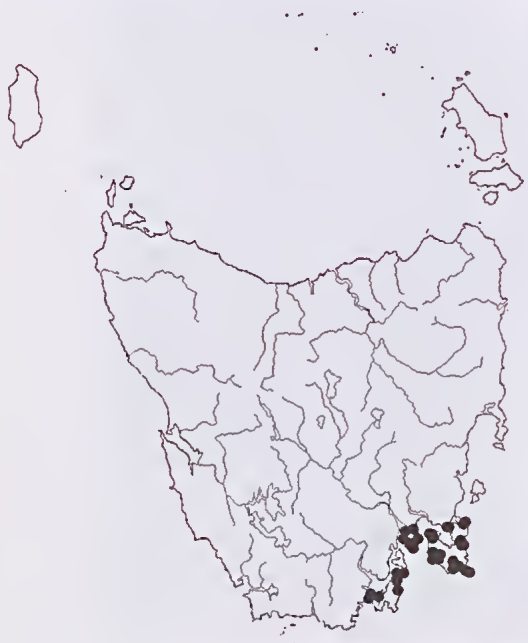

Figure 4. Distribution of *Correa alba* var. *rotundifolia DC*, based on herbarium specimens.

Labillardiere did travel and collect on Bruny Island. It is conceivable that he collected *C. alba* from the island and his collections got confused on the long journey home. Nelson (1974) has given several examples of where Labillardiere has obviously attached the wrong collection information to a specimen with some species attributed to Tasmania which do not occur in that State. In addition, South Cape and the southern half of Bruny Island are not far apart and share similar floras, both being in the South-West floristic region. It is not inconceivable that *C. alba* var. *rotundifolia* did, or does, occur at South Cape.

Distribution: *Correa alba* var. *rotundifolia* is endemic to south-eastern Tasmania where it is found on the Tasman and Forestier Peninsulas, the South Arm area (east of Hobart) and Bruny Island, and surrounding minor islands (Fig. 4).

Phenology: Flowering material has been collected from March to December; and fruiting material from March and November.

Conservation status: The populations of *C. alba* var. *rotundifolia* seen during this study were often large but fairly localised. More extensive surveys are required to assess the conservation status of the variety.

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A new species of *Bossiaea* (Fabaceae: Bossiaeeae) from Victoria

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a241625

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Abstract

Bossiaea vombata J.H. Ross is described from the Wombat State Forest, Victoria. The species is characterized by being rhizomatous, infertile, and having uniformly yellow or yellowish-white petals.

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Introduction

Among the tens of thousands of specimens accumulated by Cliff Beauglehole, is a sterile specimen (MEL 646202) of a leafless *Bossiaea* Vent. collected in May 1982 from the Musk Creek Reference Area in the Wombat State Forest, about one hundred kilometres north-west of Melbourne. At the time, the specimen was tentatively referred to *B. bracteosa* F.Muell. ex Benth.

In October 1995 my colleague Neville Walsh and I visited the Wombat State Forest in an attempt to re-locate the population from which Beauglehole had collected his specimen. At the end of an all-day search we chanced upon a small population of what was undoubtedly the same entity in full flower. As this locality is somewhat removed from the Musk Creek Reference Area, we concluded that this was not the population discovered originally by Beauglehole but a second population of the species. Numerous subsequent attempts to locate the original population have proved unsuccessful.

I returned to the site in late November 1995 to collect mature fruiting specimens and was surprised to find not a single fruit on the plants or on the ground beneath them. I assumed that I had waited too long before returning to collect fruiting material. The following year I visited the population in spring to find the plants in full bloom once again and watched as native bees gathered pollen as they traversed from one flower to another. I returned at three-weekly intervals to look for fruiting material but no fruits developed which suggested that something was amiss with the breeding system. An examination of some pollen in 1997 suggested that it was not fully formed which could possibly account for the failure of the plants to produce mature fruits. Although young fruits are initiated their development soon halts. The plants spread by rhizomes raising the possibility that the entire population is clonal.

As this Wombat State Forest entity differs from other species of *Bossiaea*, this opportunity is taken to describe it formally as a new species.

Bossiaea vombata **J.H. Ross,** ***sp. nov.***

Bossiaea bracteosae *F. Muell. ex Benth. affinis, a qua planta debiliore rhizomatosa sterili, vexillis et alis ubique flavis carinis ubique pallidus flavis, differt.*

***Type*: VICTORIA**. Wombat State Forest, [precise locality withheld for conservation purposes], 26.x.1995, *J.H. Ross 3647* (holotype: MEL 2043441).

Erect branched rhizomatous *shrub* to 1.2 m high, glabrous or with occasional scattered hairs on the margins of the young cladodes especially on the new flush of growth, cladodes flattened, with ultimate branches 0.5–1.2 cm wide, scarcely or distinctly notched at the nodes, greyish-green, terminating in a blunt point. *Leaves* reduced to narrow ovate scales 1.0–2.5 mm long, dark brown, becoming blackish, glabrous except for marginal cilia on the very young growth, inconspicuously longitudinally striate, persistent. *Flowers* solitary at the nodes, seldom paired, the pedicels 1.0–2.5 mm long, glabrous; bracts imbricate, increasing in size from the outermost basal bract to the innermost, broadly ovate, the innermost 2.0–3.1 mm long, resembling the bracteoles, rigid, coriaceous, brown, glabrous, inconspicuously longitudinally striate, persistent; bracteoles broadly ovate to obovate-oblong, 2.8–3.7 mm long, 2.2–2.8 mm wide, brown, glabrous, inconspicuously longitudinally striate, soon caducous. *Calyx* glabrous externally except for cilia on the margins of the lobes, green apart from brown tips to the lobes: 2 upper lobes 1.7–2.2 mm long excluding a tube 2.4–3.3 mm long, slightly broader and longer than the 3 lower lobes, acute; 3 lower lobes 1.6–2.0 mm long, shorter than the tube, acute. *Standard* 9.0–9.9 mm long including a claw 2.5–2.8 mm long, 8.8–9.2 mm wide, uniformly yellow; wings 9.0–9.7 mm long including a claw 2.8–3.3 mm long, uniformly yellow; keel 9.0–9.8 mm long including a claw 3.0–3.5 mm long, uniformly yellowish-white. *Stamen*-filaments 6.8–8.8 mm long; anthers orange. *Ovary* 4.5–5.2 mm long, on a stipe up to 1.5 mm long, 4–6-ovulate, glabrous. *Fruits* and seeds unknown.

Distribution and habitat: Known from a single small population in the Wombat State Forest in south-central Victoria. Occurs in open dry *Eucalyptus radiata* DC. – *E. rubida* Deane & Maiden forest with an understorey of *Acacia melanoxylon* R.Br. on reddish-brown clay-loam.

Representative specimens: Wombat State Forest, Musk Creek Reference Area, 4.iv.1982, *A.C. Beauglehole 70594* (MEL); Wombat State Forest, [precise locality withheld for conservation purposes], 28.xii.1997, *J.H.Ross 3995* (MEL).

Conservation status: Endangered. The population is restricted to an area of about 20 square metres on the roadside where it is at risk from road-widening or logging activities. The apparent inability of the species to produce seed poses a further risk to its long-term survival.

Notes: Apart from *B. vombata*, there are four other leafless *Bossiaea* species in Victoria. Of these, *B. ensata* DC. is confined to low dense coastal heathland in far East Gippsland eastwards from Marlo and *B. walkeri* F.Muell. is confined to far NW Victoria. The latter differs obviously from the rest in having large red or salmon pendulous flowers in which the standard petal is much reduced in size relative to the keel petals. As in *B. ensata*, some of the petals in *B. bracteosa* and *B. riparia* Benth. are suffused in part or throughout with red, pink or orange. *Bossiaea vombata* is the only leafless *Bossiaea* species in Victoria with uniformly yellow or yellowish-white petals, and it differs also in being rhizomatous and infertile. *Bossiaea vombata* is most closely allied to *B. bracteosa*. The conspicuous brown scarious bracteoles in *B. vombata* are soon caducous as in B. bracteosa, but *B. bracteosa* grows as a much more robust plant in Victoria where it is confined usually to altitudes above 1000 metres, on basalt, granite or shallow soils over shale.

The identity of another leafless *Bossiaea* found on the Eyre Peninsula and first collected over 150 years ago requires elucidation (referred to *B. ensata* by Weber in *Fl. South Australia* 2:689, fig.372B, 1986). There are in MEL two sheets of material labelled in Mueller's hand as having been collected near Port Lincoln. Carl Wilhelmi is given as the collector of one sheet (MEL 650949) but the other (MEL 651098) is not attributed to a collector. Mueller did not collect on the Eyre Peninsula so it is likely that both sheets were collected by Wilhelmi. It is not known whether one collection is a duplicate of the other or whether they represent two different collections. Wilhelmi did collect duplicates as there is a specimen of his at K received from Sonder. None of the specimens bears a date but Wilhelmi visited the Eyre Peninsula twice, once in 1851 and

again in 1854 (Kraehenbuehl 1990). From the limited material available, the Eyre Peninsula material does not appear to be referable to any of the Western Australian species.

Etymology: Derived from the Latin *Vombatus*, the generic name of the Common Wombat, in reference to the restricted occurrence of this *Bossiaea* in the Wombat State Forest.

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I am grateful to my colleague Neville Walsh for his companionship in the field during searches for the Wombat *Bossiaea* and for refining the Latin diagnosis, and to Jenny Tonkin, Australian Botanical Liaison Officer, for copies of Wilhelmi correspondence to W.J. Hooker and for disclosing the presence at K of a Wilhelmi duplicate from the Eyre Peninsula.

Reference

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A new species of *Callistemon* (Myrtaceae, Melaleuceae) from Victoria, Australia

a 24626

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Abstract

A new species, *Callistemon wimmerensis* N.R. Marriott and G.W. Carr (Melaleuceae, Myrtaceae) from the Wimmera in north-west Victoria, Australia, is described and illustrated. The distribution, biology, ecology and taxonomic relationships of the species are discussed. It is Critically Endangered according to IUCN criteria.

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Introduction

In Victoria 12 indigenous *Callistemon* R.Br. species are currently recognised (Spencer 1996; Molyneux 1997, 2005; Walsh & Stajsic 2007). Eleven species have been described, including four described by Molyneux (1993, 1995, 1997, 2005). The undescribed species has the informal name *C.* sp. (Wonwondah) in Walsh and Stajsic (2007); this species is the subject of this paper. In the most recent enumeration of *Callistemon*, Craven (2006) recognised 25 Australian species and one variety, which he subsumed under *Melaleuca* L. The four endemic eastern Victorian species described by Molyneux (1993, 1995, 1997, 2005) were not recognised by Craven (2006).

In 2004 one of the authors (N. Marriott) discovered and collected specimens of a new species of *Callistemon* on the banks of the MacKenzie River in the Wimmera region, north-western Victoria. Subsequent investigations by the authors and V. Stajsic (MEL) (the latter jointly with G. Carr) extended the range of the species and enabled data to be collected on its biology, ecology and conservation status. The new species, most closely related to *C. sieberi* DC., is described here. Colour determinations are made according to the 1986 reprint of the Royal Horticultural Society Colour Chart (RHS London, and Flower Council of Holland, Leiden).

Pending resolution of the taxonomy of Melaleuceae and placement of numerous related genera (Ladiges *et al.* 1999; Brown *et al.* 2001), we describe the species as a *Callistemon*.

Taxonomy

Callistemon wimmerensis N.R. Marriott & G.W. Carr, *sp. nov.*

Callistemon sieberi DC. *maxime simile, sed in habitu arborescenti (ad 10 m altum) paucicauli vel multicauli, rigide erecto, dense coronati, foliis rigidis anguste oblanceolatis, conflorescentia densa aphylla ad 6 cm longam, 3.5 cm latam, 12-49 floribus compositis, filamentis roseis 52-56 per florem, ad 13.5 mm longam, fructibus depresso-globulatis, persistentibus, ad 5 mm longam 8.5 mm latam differt.*

Figure 1a. *Callistemon wimmerensis* in situ at type locality; **b.** Very large *C. wimmerensis* in situ near type locality (scale bar = 30 cm); **c.** Holotype of *C. wimmerensis* (scale bar = 5 cm); **d.** Flower of *C. wimmerensis* from holotype (scale bar = 3.5 mm); **e.** Fruits of *C. wimmerensis* (G.W. Carr 0704-42 and N.R. Marriott, (MEL) Fruits on lower infructescence c. 3 years old; those on upper infructescence c. 10 years old. (Scale in mm)

Type: **VICTORIA.** Wimmera: Wonwondah East, c. 18 km south of Horsham on the west bank of MacKenzie River 142° 12′ 1″E 36° 54′ 29″5, 28.ix.2004, *G.W. Carr 0411–343* and *V. Stajsic* (holotype: MEL 2312043, MEL 2312044, MEL 2312045; isotypes AD, BRI, CANB, HO, K, MELU, NE, NSW, NY).

Callistemon sp. (Wonwondah) *sensu* Walsh & Stajsic (2007).

Shrub or small *tree* to c. 10 m high with single-stem (trunk) or up to c. 60 stems arising from a lignotuber; young plants narrowly erect, branches steeply ascending, ultimately a tree with a dense, narrow, crown which is higher than wide, outer branches somewhat weeping. *Bark* grey-brown, tightly adherent and slightly stringy, shallowly fissured longitudinally; bark of young branches slightly flaky with thin platelets. Young stems angular, dull red, densely tomentose-sericeous, indumentum appressed or sub-erect with hairs to c. 2.5 mm long, soon glabrous. *Leaves* moderately densely arranged on stems, steeply ascending and forming an angle of 20–35 (–60°) with stem; petiole and base of leaf blade dextrorsely twisted through 90°, thus blade with vertical orientation; pedicel flattened, 1–2 mm long × c. 1.5 mm wide. *Leaf lamina* narrowly oblanceolate or narrowly elliptic, acute, with a prominent, rigid, pungent mucro 0.6–1.75 m long; lamina (12–) 30–50 (–60) mm long × (2–) 4–7 (–8) mm wide, coriaceous, faintly revolute, dull yellow-green (Green Group 137A), pink when young, smooth *in vivo*, somewhat rough in dried material; midvein raised and prominent on abaxial surface, marginal veins prominent (leaf edges thick), lateral veins obscure *in vivo*, prominent in dried material; immersed oil glands moderately dense and obvious on abaxial surface and leaf edge, obscure on adaxial surface; mature leaves glabrous, young leaves moderately to densely appressed-sericeous with hairs to 2 mm long, young seedling leaves with patent indumentum; crushed leaves *in vivo* emit a faint *Eucalyptus*-like odour when fresh. *Conflorescence* sub-terminal on main axis or short axillary branches, (1.8–) 3.5–5.0 (–6.0) cm long × 3.2–3.5 cm diameter; axis densely pubescent in bud, moderately pubescent at anthesis, densely so at base of flowers; flowers densely arranged (12–) 20–40 (–49) per conflorescence, all flowers subtended by rigid, antrorse, caducous bracts; bracts ±triangular to lanceolate, cucullate at base, otherwise navicular, acute, 4.8–10.0 mm long × 2.6–3.7 mm wide, increasing in length distally, chartaceous with ±transparent scarious margins, especially in distal two-thirds, pubescent abaxially on margins at base with hairs to 1.0 mm long, bracts sometimes pubescent to apex, ciliate, adaxially glabrous or rarely sparsely pubescent; bracts pale brown dorsally, margins pale brown, apex, at least in proximal bracts maroon-brown, very dark at tip. *Hypanthium* barrel-shaped, 2.0–3.3 mm long × 2.2–3.5 mm wide, glabrous, smooth *in vivo*, green, with abundant but obscure immersed oil glands; ovary 3-locular, summit sunk c. 1.5 mm below hypanthium rim, covered with very dense erect hairs to 1.2 mm long; rim of hypanthium with a dense ring of erect colourless hairs to 0.5 mm long between the base of each petal. *Sepals* orbicular or rounded-triangular, 1.7–2.5 mm long × 2.5 mm wide, cucullate, pale translucent green on margins, thickened-opaque central portion with prominent oil glands, glabrous except for ciliate margins, caducous or somewhat persistent but soon eroding from rim of hypanthium. *Petals* sessile, cucullate, ±membranous, ±orbicular or elliptical-rotund, 4.0–5.0 mm long × 3.0–4.0 mm wide, attached by broad base 1.0–1.3 mm wide, pale translucent green, glabrous or margins sparsely ciliate with hairs to 0.75 mm long. *Stamens* 52–56, filaments wholly free, glabrous, 11.5–13.5 mm long, pink (RH5 Red Group 56A); anthers 1.5–1.7 mm long × 0.7–1.0 mm wide, bright yellow. *Style* pink ±straight, 13.5–14.0 mm long; stigma capitate, 0.7–0.8 mm wide. *Capsules* depressed-globular, long-persistent, light brown or grey-brown, in old fruits surface tissue exfoliating in sheets, sunken summit of ovary white-tomentose; year old capsules 3.2–3.5 mm long × 3.5–3.8 mm wide, ultimately increasing to 4.5–5.0 mm long × 8.0–8.5 mm wide. *Seeds* 0.8–1.1 mm long, ±linear, very narrowly deltoid or slightly falcate, somewhat flattened, distal end obliquely truncate, chestnut brown, shining, striate and sharply angular; contents of capsules mostly sterile (Fig. 1. a-e).

Flowering period: Late October to late December.

Specimens examined: **VICTORIA.** Wimmera: MacKenzie River, 20 x.2004, *G.W. Carr* 0410–21—0410–27 and *V. Stajsic* (MEL); MacKenzie River, 28 xi.2004, *G.W. Carr* 0411–329—0411–331 and *V. Stajsic* [MEL 2312046 & MEL 2312047; MEL 2312048 (AD); MEL 2312049 (AD)]; MacKenzie River, 28 xi.2004,

G.W. Carr 0411–338—341 [MEL 2312053; MEL 2312050 (AD); MEL 2312051 (CANB); MEL 2312052 (CAN8)]; MacKenzie River, 28 xi.2004, *G.W. Carr* 0411–342 (MEL 2312041 & MEL 2312042 AD, CANB, NSW); MacKenzie River, 28 xi.2004, *G.W. Carr* 0411–382, 0411–384, 0411–385 [MEL 2312057; MEL 2312054 & MEL 2312055 (AD); MEL 2312056 (CAN8)]; MacKenzie River, 7.iv.2007, *G.W. Carr* 0704–41, 0704–42, 0411–43, 0411–44 and *N.R. Marriott* (MEL).

Notes: *Callistemon wimmerensis* is a rigidly erect small tree to 10 m high with a dense canopy, typically higher than wide. In almost all plants examined (several hundred) the trunks were multiple, arising from a lignotuber. Stems numbered up to c. 60 per plant, indicating that the species is a post-fire lignotuberous resprouter. Stems on a single plant are mostly ±even-aged but the size (diameter) of stems indicates that fire is a rare event.

Flowering in *C. wimmerensis* occurs from late October to early December with indications of a fairly brief flowering season typical of *Callistemon*. The sympatric *C. rugulosus* DC. is abundant at all sites with *C. wimmerensis* and is assumed to have the same pollinators, but except for one plant we found no evidence of hybridisation. In *C. rugulosus* peak flowering occurs about four weeks earlier (i.e. where they are

Table 1. Comparison of *Callistemon wimmerensis* N.R. Marriott & G.W. Carr and *C. sieberi* DC.

Character	*Callistemon wimmerensis*	*Callistemon sieberi*
Habitat	Streamside, rarely extending to upper terraces, not rocky	Streamside, often rocky
Habit	Erect tree to c. 10 m high	Weeping or spreading tree to c. 8 m high
Leaves		
Indumentum	Young leaves densely appressed – sericeous, soon glabrous	Young leaves densely appressed – sericeous, soon glabrous
Length x width	(12–) 30–50 (–60) mm × (2–) 4–7 (–8) mm	(25–) 30–50 (–100) mm × (1–) 2–4 (–5) mm
Texture	Rigid, coriaceous	Rigid, but less coriaceous
Oil glands	Clearly visible abaxially, obscure adaxially	Not or hardly visible on both surfaces
Colour	Dark yellow-green, dull	Dark yellow green, sublustrous
Conflorescence	Not frondose, all flowers subtended by caducous bracts	Partially frondose, 3–9 of the distal flowers subtended by persistent leaves rather than caducous bracts
Length	(1.8–) 3.5–5.0 (–6.0) cm	(2–) 3–7 (–8) cm
Diameter at anthesis	32–35 mm	20–30 mm
Flowering time	Late October-early December	November-February
Flowers		
Arrangement	Conflorescence dense	Conflorescence with relatively distant flowers
Hypanthium	2.0–3.3 mm long × 2.2–3.5 mm wide, glabrous	c. 2.0–3.0 mm long × 2.6–3.5 mm wide, glabrous, or sometimes densely pubescent
Sepals	±Orbicular, to 2.5 mm long × 2.5 mm wide, glabrous except for ciliate margins	Semicircular, to 1.5 mm long × 2.2 mm wide, glabrous or (usually) densely sericeous adaxially, margins ciliate
Petals	±Orbicular, 4–5 mm long × 3–4 mm wide, glabrous or margins sparsely long-ciliate	Ovate-orbicular, 3.5–4.7 mm long × 3.0 4.2 mm wide, ciliate
Stamens	52–56	48–67
Filaments	11.5 13.5 mm long, pink	7.0–12.0 mm long, cream to pale yellow (occasionally pale pink)
Fruits	To 5.0 mm long × 8.5 mm diam., persisting for up to c. 13 years	To 5.0 mm long × 6.5 mm diam., persisting for up to c. 8 years

sympatric) than in *C. wimmerensis* but there is some overlap. Nothing is known about potential reproductive barriers between these species in a genus which is conspicuously promiscuous, at least in cultivation (Wrigley & Fagg 1993; Spencer 2002). *Callistemon wimmerensis*, as in other *Callistemon*, is ornithophilous (Ford *et al.* 1979) and New Holland Honeyeaters (*Phylidonyris novaehollandiae* Latham) were observed feeding on nectar from flowering plants. Numerous large native wasps (Scolliidae: probably *Campsomeris* sp.) were also observed feeding on nectar from flowers on several visits to the site and these are considered to be important pollinators of Myrtaceae (F. Douglas, pers. comm.). Honeybees (*Apis mellifera* L.) were also observed avidly gathering nectar from the base of the staminal filaments, and as nectar robbers they may adversely influence behaviour of natural pollinators, however abundant fruiting appeared universal in all *C. wimmerensis* plants examined.

Flowers of *C. wimmerensis* are protandrous with filaments lengthening to overtop the style during early anthesis, and then the style lengthens to overtop the anthers in the latter stage of anthesis. The capsules of *C. wimmerensis* are serotinous with fruits retained on branches for up to 13 years, as evidenced by the count of annual terminal shoot increments (spring-summer growth flushes). Capsules increase in length, and especially diameter, after reaching maturity at about one year post-anthesis.

Recruitment in *C. wimmerensis* is assumed to be predominantly an episodic post-fire event with mass seed release and germination to produce even-aged cohorts. This is evidenced by the serotinous fruits and apparently even-aged stems arising from a lignotuber. A low level of recruitment however was observed in localised uneven-aged stands of trees, with some immature plants judged based on their size to be no older than about five years. An environmental flow of water released along MacKenzie River in October-November 2005 (Marriott 2006a) resulted in the recruitment of a small number of seedlings. However all had died by the end of summer 2005-06. Germination *ex situ* takes c. 24–30 days.

The size of the largest *C. wimmerensis* plants indicate that it is very long-lived; the rare dead individuals observed (aside from drought deaths mentioned below) were all large and old, apparently succumbing to natural senescence. Of particular concern was the observed death of aerial parts of at least 10% of the entire metapopulation during spring-summer of 2006-07 due to the extreme ongoing drought (1996–2007). The pre-European MacKenzie River would have flowed with seasonal regularity, assuming there was not a severe drought. Today the flow to lower reaches is diverted just above the upper limit of the *C. wimmerensis* metapopulation (Distribution Heads) into Burnt Creek as part of the Wimmera/Mallee irrigation scheme. This has had dramatic negative impacts on the riparian shrub layer along the lower MacKenzie River, and now combined with the drought, severely threatens the survival of this species (Marriott 2006a, 2006b).

Callistemon wimmerensis is apparently most closely related to *C. sieberi* DC., which occurs in western Victoria to within c. 170 km of *C. wimmerensis* (Spencer 1996; Victorian Flora Information System database). *Callistemon sieberi* also occurs in South Australia c. 370 km north-west of the *C. wimmerensis* populations (Spencer & Lumley 1986). From *C. sieberi* it is distinct, based on a suite of morphological and other characters (Table 1). *Callistemon wimmerensis* does not seem closely related to the sympatric *C. rugulosus* DC. *Callistemon wimmerensis* is distinguished from *C. sieberi* in its erect habit to c 10 m (c.f. weeping habit to c 8 m in *C. sieberi*), its generally broader leaves (4-7 mm in *C. wimmerensis* c.f. 2-4 mm in *C. sieberi*) with clearly visible oil glands and a dull texture (c.f. indistinct oil glands and almost lustrous leaves in *C. sieberi*), its conflorescence with dense flowers (distant in *C. sieberi*), 32-35 mm diameter at anthesis (20-30 mm in *C. sieberi*) and with pink filaments (mostly cream to pale yellow in *C. sieberi*) and mature fruits 8.5 mm diameter in *C. wimmerensis*, c.f. 6.5 mm in *C. sieberi*.

Distribution and Conservation Status: According to IUCN criteria (IUCN 2001) *C. wimmerensis* is critically endangered, on the basis of its areal extent of less than 10 km^2, it is confined to one metapopulation, it is at present in decline, and its habitat is highly degraded.

Populations of *C. wimmerensis* occur discontinuously in a narrow band along c.13 km of streambanks on the MacKenzie River and we estimate that several hundred thousand plants occur in the metapopulation. There is

a gap of c. 7.4 km between upstream and downstream subpopulations. There are however major threatening processes. Of overriding concern is the grossly altered hydrological regime of this stream (see above). Under these modified hydrological conditions, growth, flowering and reproduction are liable to be severely compromised. In the event of fire, the absence of saturated, bare, post-fire substrates required for germination and seedling survival, as observed in other species in post-fire riparian and swamp environments, e.g. *C. citrinus* (Curtis) Skeels (Carr pers. obs.), is liable to lead to recruitment failure (Marriott 2006b).

Weed invasion is also likely to affect recruitment by competition in the germination and seedling stage. *Phalaris aquatica* L., *Ehrharta calycina* Sm., annual grasses and *Asparagus asparagoides* (L.) Druce, are the most seriously invasive exotic species in the current weed flora at the site. Due to the changed hydrological situation, *Ehrharta calycina* in particular is rapidly invading the now-dry river banks.

A further threat is the abundant, twining, leafless hemi-parasite *Cassytha pubescens* R.Br. which has killed many *Callistemon rugulosus* and some *C. wimmerensis*, and damaged canopies of both species. Much more extensive damage seems inevitable.

Habitat: *Callistemon wimmerensis* largely occurs in vegetation most closely agreeing with Plains Riparian Shrubby Woodland (Ecological Vegetation Class 659, DSE 2003) with a shrubby and grassy understorey. Data have been collected from four quadrats to describe the vegetation communities. The vegetation structural dominants or co-dominants include *Eucalyptus camaldulensis* Dehnh., *E. microcarpa* (Maiden) Maiden and *E. melliodora* A. Cunn. ex Schauer, *Acacia provincialis* A.Camus, *A. acinacea* Lindl., *Callistemon rugulosus*, *Leptospermum obovatum* Sweet, *Poa labillardierei* Steud. var. *labillardierei*, *Austrostipa* spp; *Austrodanthonia* spp., *Elymus scaber* (R.Br.) A. Love, *Microlaena stipoides* (Labill.) R.Br. var. *stipoides*, *Lomandra* spp., *Arthropodium fimbriatum* R.Br. *sens. lat.* and *A. strictum* R.Br. There is a relatively high component of exotic species, mostly annuals and perennial herbs, e.g. *Bromus diandrus* Roth, *Ehrharta calycina* Sm., *Avena barbata* Pott ex Link and *Phalaris aquatica*. At the upper limits of the population on MacKenzie River, *C. wimmerensis* occurs in very different vegetation, most closely conforming with Plains Swampy Woodland (Ecological Vegetation Class 651) in a broad drainage line without an incised stream channel. In this location the overstorey dominants are *Eucalyptus ovata* Labill. var. *ovata*, *E. camaldulensis* and *E. viminalis* Labill. subsp. *cygnetensis* Boomsma, but with a sedge-rich understorey, including three *Lepidosperma* species. *Callistemon wimmerensis* forms very dense closed stands here with almost no field-layer vegetation.

Callistemon wimmerensis occurs on streambanks and alluvial terraces on pale brown, silty alluvium (over a sandstone bedrock) derived predominantly from Upper Silurian – Lower Devonian quartzose sandstones of the Grampians. Under a normal hydrological regime most *Callistemon* plants would be growing at the edge of the water or the roots would be ±permanently moist in the zone subject to regular inundation. Plants generally only occur within a few metres of the stream bank and not on the extensive floodplain which is subject to only rare inundation. Where substrates are much more sandy, *C. wimmerensis* may extend upslope to the upper alluvial terrace.

Etymology: Latin rendering of the place-name Wimmera to which the species is endemic.

Recommended vernacular name: Wimmera Bottlebrush.

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Observations on some Tasmanian species of the lichen genus *Megalaria* (Lecanorales: Megalariaceae)

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Abstract

Three species of *Megalaria* Hafellner (Lecanorales: Megalariaceae) are described and discussed, with special emphasis on apothecial pigments and ascospore size: *Megalaria laureri* (Th.Fr.) Hafellner, *M. melaloma* (C.Knight) Kantvilas *comb. nov.* and *M. subtasmanica* Kantvilas *sp. nov.* The names *Catillaria tasmanica* Räsänen, *Patellaea scutata* Rodway and *Patellaria biclipea* Shirley are considered synonyms of *Megalaria melaloma*.

Muelleria 26(2): 64-71 (2008)

Introduction

The genus *Megalaria* (Lecanorales: Megalariaceae) was introduced by Hafellner (1984) to accommodate the distinctive crustose lichen, *M. grossa* (Pers. ex Nyl.) Hafellner. This widespread species had previously been included within *Catillaria* A.Massal. and *Catinaria* Vain., but study of the ascus structure of these genera revealed that *M. grossa* was clearly different, having an ascus with an amyloid tholus penetrated almost completely by a conical to barrel-shaped, non-amyloid axial body (masse axiale). In contrast, *Catillaria* and *Catinaria* have asci with a uniformly amyloid tholus, although additional anatomical differences further separate these superficially similar genera.

The introduction of a new genus led to the reappraisal of other species included within obviously heterogenous groups such as *Catillaria* as generally applied in the sense of A. Zahlbruckner; that is, essentially crustose lichens with lecideine apothecia and one-septate, hyaline ascospores. Thus, other species were soon added to *Megalaria* by Schreiner and Hafellner (1992), Hafellner in Nimis (1993), Ekman and Tonsberg (1996), Fryday (2004a, 2004b), Galloway (2004), Kalb (2007) and Lendemer (2007). Ekman and Tønsberg (1996) dicussed the delimitation of the genus, which they characterised by the crustose thallus, lecideine apothecia with a proper excipulum of radiating hyphae lacking enlarged cells at the outer edge, the presence of greenish, K+ green, N+ reddish pigments in the epithecium, simple or sparingly branched paraphyses, one-septate, ellipsoid, hyaline, non-halonate, single-walled ascospores, and an ascus with an amyloid tholus pierced by a conical to barrel-shaped axial body surrounded by a narrow, usually more intensely amyloid adjacent zone. The photobiont of *Megalaria* is thought to be the chlorococcoid algal genus *Dictyochloropsis* Geitler (Tschermak-Woess 1984). A good general account of the genus is also offered by Galloway (2007).

A related genus, *Tasmidella* Kantvilas, Hafellner & Elix, was described by Kantvilas *et al.* (1999). It differs from *Megalaria* primarily by having simple, double-walled ascospores and bacilliform to filiform (rather than ellipsoid to ampulliform) conidia. These authors (*op. cit.*) also discuss the systematic position of *Megalaria* and *Tasmidella*, maintaining

both in the family Megalariaceae. More recently, Kalb (2007) segregated the genus *Catillochroma* Kalb from *Megalaria*, on the basis of its having a layered excipulum with a prosoplectenchymatous outer layer and an inner layer of interwoven hyphae inspersed with crystals. Two species of this genus are represented in the Tasmanian flora and were previously included within *Megalaria*: *C. melanotropa* (Nyl.) Kalb and *C. pulverea* (Borrer) Kalb.

Megalaria is a genus of cool, moist, oceanic climates (Ekman & Tønsberg 1996). It appears to be well represented in cool temperate areas of the Southern Hemisphere, where it occurs chiefly as a wet forest epiphyte, but also on rocks, soil, wood and bark in other vegetation types. Two taxa from Campbell Island were described recently by Fryday (2004a), whereas Galloway (2007) deals with 11 taxa from New Zealand (some of which are now placed in *Catillochroma*). Collections of *Megalaria* are well represented in Australian herbaria, usually under a variety of 'dust-bin' names such as *Catillaria*, and a glance at the early Australian lichen literature indicates that several species of the genus have been described in the past (under *Lecidea*, *Patellaria*, *Catillaria* and other genera). To unscramble this plethora of names and collections will require a long and demanding study. The aim of the present paper is more limited in focus, being to ascribe names to three of the more common and widespread species that are frequently cited in the course of Tasmanian floristic, ecological or conservation studies, and to account for some of the older names in the literature that have fallen into disuse.

Material and Methods

The study is based on specimens collected by the author and housed in the Tasmanian Herbarium (HO), with some duplicates distributed to BM, CANB, GZU and herb. Vězda. Anatomical investigations were conducted on hand-cut sections of thalli and apothecia mounted in water, 10% KOH (K), Lugol's iodine, concentrated HNO_3 (N) and concentrated HCl (H). Measurements of ascospores are based on 100–200 observations each and are presented in the format: lowest value-*mean*-highest value. Chemical constituents were examined by thin-layer chromatography using standard methods (Orange *et al.* 2001). Terminology for apothecial pigments and the procedures for their identification and characterisation follows Meyer and Printzen (2000). Nomenclature of ascus types follows generally acceptable accounts (e.g. Hafellner 1984, Purvis *et al.* 1992).

Taxonomy

1. *Megalaria laureri* (Th.Fr.) Hafellner, *in* P.L. Nimis, *The Lichens of Italy*: 429 (1993).

Thallus crustose, effuse to patchy, smooth to rather unevenly warty, or composed of tiny, scattered granules to c. 0.2 mm wide, whitish grey, lacking isidia or soredia, ecorticate, mostly delimited by a black prothallus; photobiont a unicellular green alga with cells globose, 6–14 µm diam.

Apothecia to 0.9 mm diam., scattered or in irregular clusters of 2–3, superficial, highly basally constricted to sometimes almost subpedicellate; disc plane at first, later convex, matt, black or rarely brown-black, epruinose; margin concolorous with the disc, persistent but sometimes obscured in oldest, most convex apothecia. *Excipulum* in section 60–80 µm thick, composed of radiating, branched and anastomosing, conglutinated hyphae 1.5–2 µm thick, at the outer edge with a thin, ±discontinuous band of grey-green to blackish green pigment, K±intensifying greenish, N+ crimson, within with a dilute to very concentrated purple-pink pigment, ±intensifying in K, N+ pale orange, extending beneath and subtending the hymenium and hypothecium. *Hypothecium* 40–100 µm thick, not inspersed with oil droplets, purple-brown to purple-pink, K+ intensifying pink, N+ pale orange above, dilute greenish grey, K±intensifying green, N+ crimson below. *Hymenium* 70–90 µm thick, not inspersed, mostly hyaline but overlain with a continuous or patchy layer to c. 20 µm thick of blackish green and purple-pink pigments (as in the excipulum). *Asci* 8-spored, clavate, 60–85 × 14–22 µm, with a well developed amyloid tholus penetrated almost entirely by a conical masse axiale bordered by a narrow, more intensely amyloid zone (i.e. approximating the *Biatora*-type); ocular chamber usually not developed. *Paraphyses* lax in K, simple or occasionally branched and anastomosing, 1–2 µm wide; apices capitate, 4–5 µm wide, persistently conglutinated with epihymenial pigments (as above). *Ascospores* ellipsoid to ovate, 1-

septate, (15–)16–*19.6*–24(–26) × 7–*8.6*–10 µm. *Pycnidia* not observed. Figs. 1A, 2A.

Chemistry: no substances detected by t.l.c.

Remarks: *Megalaria laureri* was first recorded for Tasmania by Wetmore (1963) on the basis of a dubious statement by Almborn (1948), and has been maintained in various checklists since (e.g. Kantvilas 1994, McCarthy 2008). However, no Tasmanian specimens of the species have been available for study until now, and it is likely that the concept of the species employed by Almborn (1948) is different to that in use today. The record from Queensland (McCarthy 2008) cannot be confirmed.

This species is recognised by the distinctive pigments in its excipulum, hypothecium and epihymenium. The dominant, purple-pink pigment approximates 'atra-red' of Meyer and Printzen (2000); this intensifies pinkish in K, is ±unchanged in H and reacts N+ orange. Also present in the epihymenium and the hypothecium is 'cinereorufa-green': K±green intensifying, H±blue-green, N+ crimson. In very occasional sections, a thin band of 'hypnorum-blue' may also be present in the upper part of the hypothecium: K+ turquoise, H±violet-blue, unchanged in N. The pigments may occur in discrete patches or overlay each other, so their detection is not always straightforward. Although

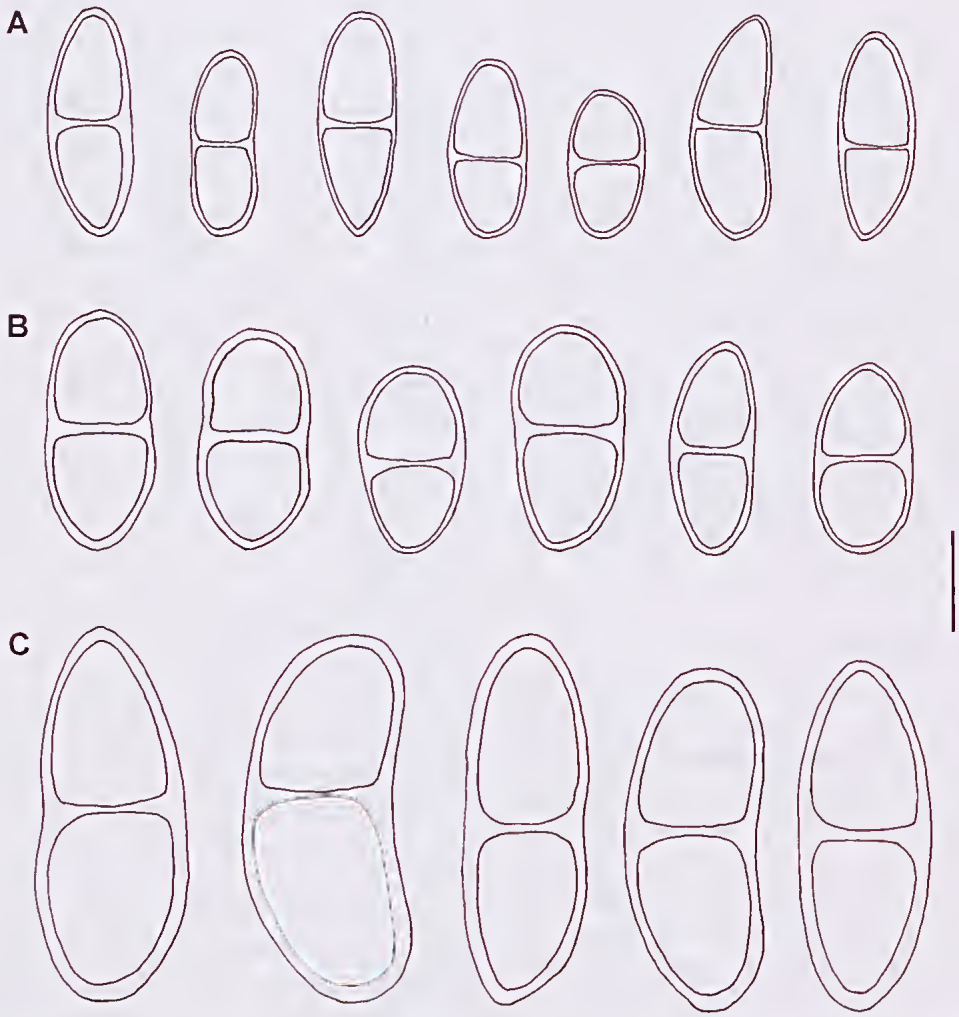

Figure 1. Comparison of ascospores of *Megalaria* species. A: *M. laureri* (*Kantvilas 91/87*); B: *M. melaloma* (*Kantvilas 214/99*); C: *M. subtasmanica* (*Kantvilas 57/87*). Scale = 10 µm.

all these pigments may also occur in other species of *Megalaria* to some degree, the predominance of the 'atra-red' pigment is highly characteristic.

Additional descriptive data for this species are given by Coppins (1992) (for Great Britain, under *Catillaria*) and by Brodo *et al.* (2001) (for North America). Whereas Tasmanian specimens have the same pigments and general habit, their ascospores are relatively longer and broader [cf. 12–18 × 5–7 µm (Coppins 1992); 13–18(–24) × 5–7(–8) µm (Brodo *et al.* 2001)]. Thus the identification of the Tasmanian specimens is provisional at this stage.

Distribution and ecology: *Megalaria laureri* is widespread albeit often localised in temperate areas of the Northern Hemisphere. It appears to be uncommon in Tasmania where it is known from only two collections: one from the trunk of *Banksia* in wet eucalypt forest and the other from a young trunk of *Nothofagus cunninghamii* (Hook.) Oerst. in cool temperate rainforest.

Specimens examined: **TASMANIA.** Yarlington Tier, 42°32'S 147°18'E, 620 m alt., 8.xi.1987, *G. Kantvilas 91/87* (GZU, HO); Montana Falls, 41°34'S 146°36'E, 290 m alt., 26.xi.1988, *J.A. Curnow 2063* (CANB, HO, M). **UNITED STATES OF AMERICA: MICHIGAN.** Alger County, W of Kingston Lake, 16.ix.1970, *R.C. Harris 6055* (HO, MSC).

2. *Megalaria melaloma* (Knight) Kantvilas *comb. nov.*

Lecidea melaloma Knight, *Trans. Linn. Soc. London*, ser. 2, 2: 45 (1882); *Catillaria melaloma* (Knight) Zahlbr., *Cat. Lich. Univ.* 4: 21 (1926).

Type: New South Wales ['in the neighbourhood of Sydney'], *C. Knight* [vol. 204, p. 24, no. 24] (WELT–holotype!).

= *Catillaria tasmanica* Räsänen, *Ann. Bot. Soc. Zool.-Bot. Fenn. "Vanamo"* 21: 3 (1944). Type: Australia, Tasmania, prope cataractam Newton [New Town Falls], ad corticem arborum, 1887, *R.A. Bastow* (G–holotype!).

= *Patellaea scutata* Rodway, *Pap. Proc. R. Soc. Tasm.* (1924): 93 (1925). Type: Tasmania, Cascades, on bark of *Bedfordia salicina*, 27 June 1896, *L. Rodway* (HO–holotype!).

= ? *Patellaria biclipea* Shirley, *Pap. Proc. R. Soc. Tasm.* (1893): 217 (1894); *Megalospora biclipea* (Shirley) Zahlbr., *Cat. Lich. Univ.* 4: 86 (1926). Type: [Tasmania] St Crispin's, *W.A. Weymouth 155a* (Type specimen not located).

Thallus crustose, 50–100(–150) µm thick, generally smooth, effuse and continuous, sometimes cracked, abraded, rather gnarled and scurfy, whitish cream, glaucous grey to pale brownish, not delimited, lacking isidia or soredia, ecorticate; photobiont a unicellular green alga with cells globose, 7–10(–16) µm diam.

Apothecia 0.8–1(–1.5) mm diam., scattered, superficial, basally constricted; disc plane at first, later convex, matt, typically jet-black but sometimes pale greyish, brown or piebald, epruinose; margin persistent except in oldest, most convex apothecia, often rather glossy, typically concolorous with the disc, or darker when the disc is pale, rarely a little brownish at the sides. *Excipulum* in section 40–80 µm thick, composed of radiating, branched and anastomosing, conglutinated hyphae to c. 2 µm thick, with a grey-green, olive-green to bluish green, K±intensifying greenish, N+ crimson pigment at the edge, sometimes extending within in

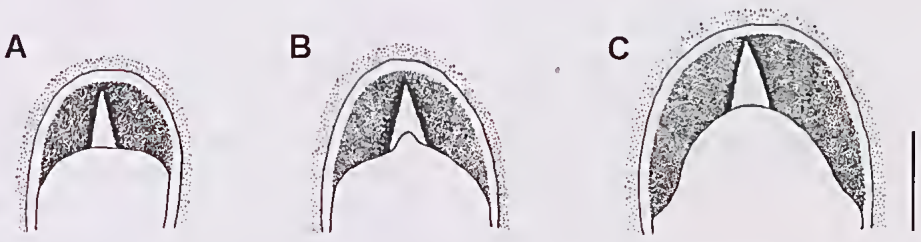

Figure 2. Comparison of the ascus apex of *Megalaria* species, observed in dilute Lugols' iodine after pre-treatment with 10% KOH (amyloid tissues stippled). A: *M. laureri* (*Kantvilas 91/87*); B: *M. melaloma* (*Kantvilas 207/80*); C: *M. subtasmanica* (*Kantvilas 264/93*). Scale = 10 µm.

streaks; dilute patches of a purple-brown to pinkish pigment, ±unchanged or intensifying in K, N+ pale orange sometimes also present. *Hypothecium* 80–200 µm thick, inspersed with oil droplets, hyaline to pale straw-coloured and typically K±pale yellowish in the lower part, in the upper part with a band c. 30–50 µm thick, diffusely pigmented greyish green to olive-brown (as in the excipulum). *Hymenium* 80–120 µm thick, not inspersed, mostly hyaline but overlain with a continuous or patchy layer 5–20 µm thick of blackish green, greenish blue to olive-green pigment (as in the excipulum), K±unchanged or intensifying greenish, N+ crimson. *Asci* 8-spored, clavate, 65–105 × 20–30 µm, with a well-developed amyloid tholus penetrated ±entirely by a conical masse axiale and bordered by a narrow, more intensely amyloid zone (i.e. ±of the *Biatora*-type); ocular chamber blunt, not prominent. *Paraphyses* lax in K, simple or occasionally branched and anastomosing, 1.5–2 µm wide, with apices unpigmented, generally not capitate or sometimes swollen to 4 µm. *Ascospores* ellipsoid to ovate, 1-septate, (15–)16–*22.5*–28(–31) × (7–)8–*10.1*–12(–14) µm. *Pycnidia* not observed. Figs. 1B, 2B.

Chemistry: atranorin detected occasionally by t.l.c.

Notes on type specimens: Knight's type of *Lecidea melaloma* is an excellent and typical example of this taxon. The type specimen of *Catillaria tasmanica* studied consists of fourteen fragments of bark bearing a mixture of several lichen species, including two species of *Megalaria*. These differ clearly by their ascospore size, but are superficially indistinguishable, both having jet-black, glossy apothecia with a persistent margin, and a thin to moderately thick, whitish thallus; they also have identical apothecial pigmentation. One of the taxa is identical to *M. melaloma* whereas the other is the species described below as *M. subtasmanica* Kantvilas. Unfortunately it seems inappropriate to retain the epithet 'tasmanica' for the latter, even though it is the better represented of the two lichens in this specimen: the original description of *C. tasmanica* (Räsänen 1944) explicitly gives the spore measurements as 26–30 × 12–14 µm, indicating that the author was intending to describe what is now recognised as *M. melaloma*.

Rodway's *Patellaea scutata* was described as a non-lichenised fungus (Rodway 1925). The type specimen is a particularly abundant and well-developed collection of *M. melaloma*.

Shirley's type specimen of *Patellaria biclipea*, collected by the prolific Tasmanian cryptogam collector, W.A. Weymouth, has not been located, despite extensive searches of likely herbaria (Kantvilas 1988). However, the description (Shirley 1894) matches *M. melaloma* perfectly, and that taxon occurs in great abundance at the same locality today.

Remarks: *Megalaria melaloma* is characterised by the generally smooth, crustose thallus, the epruinose, usually jet-black apothecia with concolorous disc and margin, the essentially hyaline or at most dilutely pigmented excipulum and hypothecium, the predominance of greenish pigments in the epithecium and excipulum, the eight-spored asci and the relatively small ascospores. The last two characters separate *M. melaloma* from *M. subtasmanica* (see below), which has distinctly larger ascospores (mostly 30–44 × 12–20 µm) that occur 2–6 per ascus. The lack of opaque, essentially blackish green pigments in the hypothecium and excipulum distinguish it from several other species, including the common and cosmopolitan *M. grossa*, which is widespread in Tasmania and mainland Australia.

Megalaria species in general are well characterised by their thallus morphology, apothecial pigmentation and ascospore size, characters that are usually cited in even the briefest of published descriptions. No other known taxa appear to combine the same characters as does *M. melaloma*, although the existence of some older, as yet overlooked published name for such a common and conspicuous species cannot be discounted. Thus, further synonyms may well come to light as investigations of the early collections of Australasian lichens continue.

The greenish pigmentation found in the epithecium and excipulum approximates 'cinereorufa-green' of Meyer and Printzen (2000); it reacts N+ crimson-red, H+ blue-green and intensifies greenish in K. Although the appearance of the pigment in section varies from an almost blackish green to a quite dilute pale greenish or with hints of olive or brown, these variations appear to be due to concentration alone. Sometimes the pigment may appear to have quite strong turquoise-bluish tones, but nevertheless reacts the same in K, H and N. In some specimens, additional dilute tinges of a pinkish or purple-brown pigment may also be present,

but in this taxon, it does not appear to be of taxonomic significance. This pigment approximates 'atra-red' (Meyer & Printzen 2000) and reacts N+ orange, but is ±unchanged in K and H.

The thallus chemistry of the species is ambiguous. Some specimens, especially those with a thicker, paler thallus, contain trace amounts of atranorin, but this compound has a sporadic occurrence in many crustose lichens and especially those growing in exposed, well-lit conditions. Thallus chemistry does not appear to be a useful character in *Megalaria* taxonomy in general (Ekman & Tønsberg 1996), with the exception of those taxa recently transferred to the genus *Catillochroma* by Kalb (2007).

Ekman and Tønsberg (1996) discuss the variation in ascus structure between *M. grossa* (the type species of the genus) and other taxa included in *Megalaria* or, currently, the related genus *Catillochroma*. In *M. melaloma* and the other species treated in the present paper (*M. laureri* and *M. subtasmanica*), the ascus approximates the *Biatora*-type. There is a well-developed, amyloid tholus almost completely penetrated by a conical masse axiale with an acute apex. Using *very* dilute Lugol's solution after pretreatment with K, a narrow, more intensely amyloid zone is evident adjacent to the masse axiale, although the internal differentiation of the tholus can be difficult to discern. The ocular chamber is relatively short and blunt to ±absent (see Figs 2A–C).

Distribution and ecology: *Megalaria melaloma* is a common and widespread epiphyte in a wide range of wet forest types, including *Nothofagus*-dominated cool temperate rainforests and *Eucalyptus*-dominated sclerophyll forests. Although apparently preferring hosts with smooth bark (for example *Acacia*, *Atherosperma*, *Pittosporum*, *Pomaderris*), it may also occur on more fibrous substrata such as on *Bedfordia* or species of Myrtaceae. Rarely it has been found on rocks or charcoal. It is typically a component of a rich association of crustose and small foliose lichens, including *Thelotrema lepadinum* (Ach.) Ach., and species of *Parmelia*, *Pertusaria* and *Mycoblastus*. Also commonly present in such lichen communities are several species with a superficially similar appearance to *M. melaloma* (i.e. with a whitish crustose thallus and black, lecideine apothecia), including *Megalaria subtasmanica* Kantvilas, *Bacidia wellingtonii* (Stirt.) D.J.Galloway, *Sarrameana albidoplumbea* (Hook.f. & Taylor) Farkas and *Hafellia* species; to distinguish these lichens unequivocally requires microscopic examination of apothecial sections and squashes.

Specimens studied are from Tasmania, Victoria, the A.C.T. and New South Wales, indicating a south-eastern Australian distribution.

Selected specimens examined (total = 35): **TASMANIA.** South Sister, near summit, 41°32'S 14B°10'E, B00 m alt., 10.xi.2004, *G. Kantvilas 369/04* (HO); St Crispins Well, 27.v.1987, *G. Kantvilas 66/87* (HO); Waterwarks Gully, 42°5S'S 147°19'E, viii.1917, *L. Radway* (HO); Bermuda Road, 43°04'S 146°57'E, 440 m alt., 25.x.1990, *G. Kantvilas 584/90 & J. Jarman* (HO, IMI); Western Creek Track, 41°41'S 146°2B'E, 9B0 m alt., 20.xi.2005, *G. Kantvilas 345/05* (HO); Little Fisher River, 41°4S'S 146°20'E, 820 m alt., 23.iv.19B2, *G. Kantvilas 111/82* (BM, HO); Telopea Raad near Ben Nevis, B70 m alt., S.xi.19B0, *G. Kantvilas 544/80* (herb. Vězda, HO); track to Lady Barron Falls, 42°42'S 146°42'E, 2S0 m alt., 19.v.1973, *G.C. Bratt 73/535* (HO). **NEW SOUTH WALES.** Braidwood district, SE of Rassi, 19.xii.1967, *W.A. Weber & D. McVean L-49319* (COLO, HO); Mt William, Barrington Tops N.P., 32°04'30"S 151°2B'00"E, 1400 m alt., 30.vi.19BB, *G. Kantvilas 286/88* (HO, NSW); Parkers Gap, 3S°3S'S 149°27'E, 11.v.19B6, *G. Kantvilas s.n.* (HO). **AUSTRALIAN CAPITAL TERRITORY.** head of Blundells Creek, 35°19'S 14B°51'E, B00 m alt., 17.iv.1994, *G. Kantvilas 74/94* (HO). **VICTORIA.** Mt Danna Buang, 37°42'S 14S°41'E, 1200 m alt., 23.xii.1993, *G. Kantvilas 113/93, P.M. McCarthy & S. Louwhaff* (HO). Errinundra Plateau, Goonmirk Rd, 37°16'29"S 148°S3'06"E, 112S m alt., 16.iv.2008, *G. Kantvilas 146/08 & J. Elix* (HO, MEL); Baw Baw NP., Mushroom Rocks, 37°S3'S 146°21'E, 1200 m alt., 13.iv.200B, *G. Kantvilas 142/08* (HO, MEL); Marewell NP., Fosters Gully, 3B°21'S 146°23E, 200-300m alt., 12.iv.200B, *G. Kantvilas 157/08* (HO, MEL).

3. *Megalaria subtasmanica* Kantvilas *sp. nov.*

Thallo crustaceo, effuso, apotheciis nigris, typice ad marginem pigmento viridulo tinctis, excipulo hypothecioque interne praecipue hyalinis, a Megalariae melalomae *similissima sed ascosporis maioribus, (24–)30–44(–46) µm longis, 12–20(–21) µm latis differens.*

Type: **AUSTRALIA: TASMANIA**. Little Fisher River, 41°45'S 146°20'E, on *Atherosperma moschatum* in rainforest, 850 m alt., 15.v.1987, *G. Kantvilas 57/87* (HO– holotype).

Thallus crustose, effuse to *c.* 100 µm thick, continuous, smooth to shallowly cracked to rather scurfy, typically whitish cream, occasionally dull pale brownish, not delimited, lacking soredia or isidia, ecorticate; photobiont a unicellular green alga with cells globose, 6–10 µm diam.

Apothecia to 1(–1.3) mm diam., scattered, superficial, basally constricted; disc plane to convex, matt, usually jet-black, occasionally dark brown, brown-grey or ±piebald, epruinose; margin typically concolorous with the disc, persistent, often somewhat glossy. *Excipulum* in section 60–120 µm thick, composed of radiating, anastomosing, highly gelatinised hyphae 1–1.5 µm thick, mostly hyaline within, but with patchy dilute pigments, especially towards the outer edge and adjacent to the hymenium; pigment mostly grey-green, olive-brown to blue-green, K±unchanged or intensifying greenish, N+ crimson, sometimes also with a purple-brown to pinkish pigment, ±unchanged in K, N+ pale orange. *Hypothecium* to 200 µm thick, occasionally inspersed with oil droplets, typically hyaline to dilute straw-coloured and K+ weakly yellowish, sometimes with a subhymenial upper band to c.80 µm thick, pigmented greenish or olive brownish (as in the excipulum). *Hymenium* 120–160 µm thick, not or only very rarely inspersed with scattered oil droplets, hyaline but overlain by a continuous to patchy epihymenial layer 10–15 µm thick of olive-green to blackish green pigment, K±intensifying greenish, N+ crimson (as in the excipulum). *Asci* elongate-clavate, at first 8-spored but typically with a few spores soon aborted and therefore generally (2–)4–6-spored, 110–140 × 26–42 µm (very few intact asci observed), with a well-developed amyloid tholus penetrated ±entirely by a conical masse axiale and bordered by a narrow, more intensely amyloid zone (i.e. ±of the *Biatora*-type); ocular chamber not developed. *Paraphyses* lax in K, simple to very sparsely branched, 1–2 µm thick; apices usually neither pigmented nor swollen, sometimes expanded to 3–4 µm and distinctly greenish. *Ascospores* ellipsoid to ovate, sometimes fabiform, (24–)30–*35.1*–44(–46) × 12–*14.6*–20(–21) µm. *Pycnidia* not observed.

Chemistry: atranorin detected occasionally by t.l.c.

Etymology: The specific epithet refers to the close similarity of the new species with *Catillaria tasmanica* (= *Megalaria melaloma*), the name that has been frequently misapplied to the species in Tasmanian literature.

Remarks: Given the abundance of this taxon in herbarium collections, and its conspicuous nature in the field, it is surprising that no existing name could be found in the literature. Even more remarkable is the fact that its sympatric look-alike, *M. melaloma*, has been described previously no fewer than four times. These two taxa share a ±smooth thallus and identical apothecial pigmentation, dominated by 'cinereorufa-green' with traces of 'atra-red' (Meyer & Printzen 2000). A particularly notable character is the chiefly hyaline excipulum and hypothecium that, together with the pigment, separate these species from most other species of the genus. *Megalaria subtasmanica* and *M. melaloma* differ from each other by their ascospore size. In the former, the asci are correspondingly larger and the hymenium taller. The size character is consistent and has been confirmed in several hundred observations spanning scores of apothecial sections and specimens. In both species, the asci approximate the *Biatora*-type (see under *M. melaloma*) (Fig. 2).

Distribution and ecology: *Megalaria subtasmanica* is a common epiphyte of cool temperate rainforest and wet eucalypt forest. It colonises understorey trees and shrubs, including those with smooth bark (e.g. *Acacia, Pomaderris*), fibrous bark (members of the Asteraceae) and papery bark (Myrtaceae). Like *M. melaloma*, with which it frequently occurs in closely intermixed colonies (to the extent that most herbarium collections of these species are usually mixed), it is a member of a rich assemblage of foliose and crustose lichens.

The species is known at present from Tasmania, King Island and the south-west of Western Australia, but it can be expected to be more widespread.

Selected specimens examined (total = 24): **TASMANIA.** Nye Bay, 43°04'S 145°41'E. 20 m alt., 4.ii.1986, *A. Mascal 12059* (HO); creek crassing Strickland Avenue, 42°56'S 147° 16'E, 19.vi.1963, *G.C. Bratt 278 & M.H. Bratt* (HO); Millhouses Falls, Huon Raad, 42°58'S 147°12'E, 420 m alt., 3.iii.1893, *W.A. Weymouth 286c* (HO); Savage River Pipeline Raad by 14.5 km peg, 41°16'S 145°19'E, 8.xii.1993, *G. Kantvilas 264/93* (HO); Yarlington Tier, 42°32'S 147°18'E, 620 m alt., 30.xi.1988, *G. Kantvilas 585/88* (HO); King Salaman Cave, 41°33'S 146°15'E, 400 m alt., 27.xi.1988, *J.A. Curnaw 2156* (CANB, HO); King Island, Yarra Creek Crossing, 40°00'S 144°05'E, 80 m alt., 6.iv.1999, *A. Razefelds s.n.* (HO). **WESTERN AUSTRALIA.** Beedelup Falls, 34°25'S 115°52'E, 140 m alt., 11.x.1992, *G. Kantvilas 335/92 & J. Jarman* (HO, PERTH); 100-Year-Old Farest, c. 13 km SSW af Manjimup, 34°21'S 116°04'E, 12.x.1992, *G. Kantvilas 370/92 & J. Jarman* (HO, PERTH).

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Lecanora subtecta, an Australian species in the *Lecanora symmicta* group (Lecanorales)

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Abstract

The new combination *Lecanora subtecta* (Stirt.) Kantvilas & LaGreca is introduced for an Australian member of the *L. symmicta* (Ach.) Ach. group. The species is described and illustrated, and features that distinguish it from other members of the complex are discussed.

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Introduction

Lecanora symmicta is a widespread species in temperate latitudes in the Northern Hemisphere, where it grows on bark, wood and worked timber. It is described and/or illustrated in a wide range of European and American floras (e.g. Brodo *et al.* 2001; Hawksworth & Dalby 1992; Nimis 1993; Ryan *et al.* 2004; Wirth 1995) although all authors agree that it represents a complex of poorly understood species that require considerable study (LaGreca *et al.* 2000; Printzen & May 2002; Sliwa & Wetmore 2000). Some progress with regards to species circumscription within the group has been made—for example, the segregation of *L. brucei* Printzen (Ryan *et al.* 2004)—but much work remains to be done.

The species has been recorded in Australasia (Galloway 1985, 2007; Lumbsch & Elix 2004) where similar problems of delimitation and taxonomy are recognised. Whilst the name *Lecanora symmicta* is in use in regional checklists (e.g. McCarthy 2008), it is likely that ultimately this name will have more limited geographical and taxonomic application.

Study of types of early Australian lichens has revealed a name for one of the entities of the complex which is frequently encountered in Tasmania. The appropriate nomenclatural change is introduced here.

Material and methods

The study is based on material housed in the Tasmanian Herbarium (HO) and comparative material in BM. Anatomical investigations were conducted on hand-cut sections of thalli and apothecia mounted in water, 10% KOH, concentrated HNO_3, lactophenol cotton blue and Lugol's iodine. Measurements of ascospores are based on at least 70 observations and are presented in the format: lowest value-*mean*-highest value. Chemical constituents were identified routinely by thin-layer chromatography using standard methods (solvents A, B′, and C: Culberson & Ammann 1979; Culberson & Johnson 1982); selected analyses were also undertaken by Prof J.A. Elix (Canberra) using high-

performance liquid chromatography (Feige *et al.* 1993). Nomenclature of ascus types follows Hafellner (1984). Nomenclature of apothecial pigments follows Meyer and Printzen (2000).

Taxonomy

Lecanora subtecta (Stirt.) Kantvilas & LaGreca *comb. nov.*

Lecidea subtecta Stirt., *Trans. Glasgow Soc. Field Naturalists* 4: 93 (1876).

Type: **TASMANIA:** "ad ligna decorticata in Tasmania", *H. Paton* (lectotype, *fide* D.J. Galloway *ined.*– BM000022188!).

Thallus crustose, ecorticate, not delimited, effuse to immersed in the substratum and ±inapparent, or pale glaucous grey, rimose-areolate and rather scurfy, or ±granular, with the granules 0.05–0.1 mm wide; soredia absent; photobiont *Trebouxia*-like, with individual cells irregularly globose, 10–24 µm wide.

Apothecia biatorine, 0.12–0.5 mm wide, roundish to irregularly rhomboid, scattered or, more typically, crowded together and rather misshapen, occasionally fusing in irregular, cerebriform clusters to 2 mm wide; disc pale orange-pink, orange-yellow to yellow, sometimes piebald greenish grey, plane at first, soon becoming convex or undulate, usually sparsely to densely beset with a coarse lemon-yellow pruina; margin very thin, usually very soon excluded and not evident. *Excipulum* in section colourless, 10–40 µm thick at the sides, mostly becoming excluded, poorly differentiated from the hymenium, composed of conglutinated, radiating, branched and anastomosing, loosely interwoven hyphae 1–1.5(–2) µm thick, lacking photobiont cells. *Hypothecium* hyaline, 40–100 µm thick, composed of loosely interwoven, anastomosing hyphae *c.* 0.6 µm thick, subtended by a ±continuous band of photobiont cells. *Hymenium* 42–50 µm thick, mostly hyaline but in the upper part usually overlain or inspersed with golden granules that fluoresce pale to vivid yellow in polarised light and dissolve in KOH, very rarely with traces of 'cinereorufa-green' pigment, K±greenish intensifying, N+ crimson. *Asci* clavate, eight-spored, 30–42 × 9–14 µm, of the *Lecanora*-type, with a well-developed amyloid tholus penetrated entirely by a cylindrical, weakly amyloid masse axiale with ±parallel flanks; ocular chamber blunt. *Paraphyses* 1–1.5 µm thick, simple to occasionally branched, rather

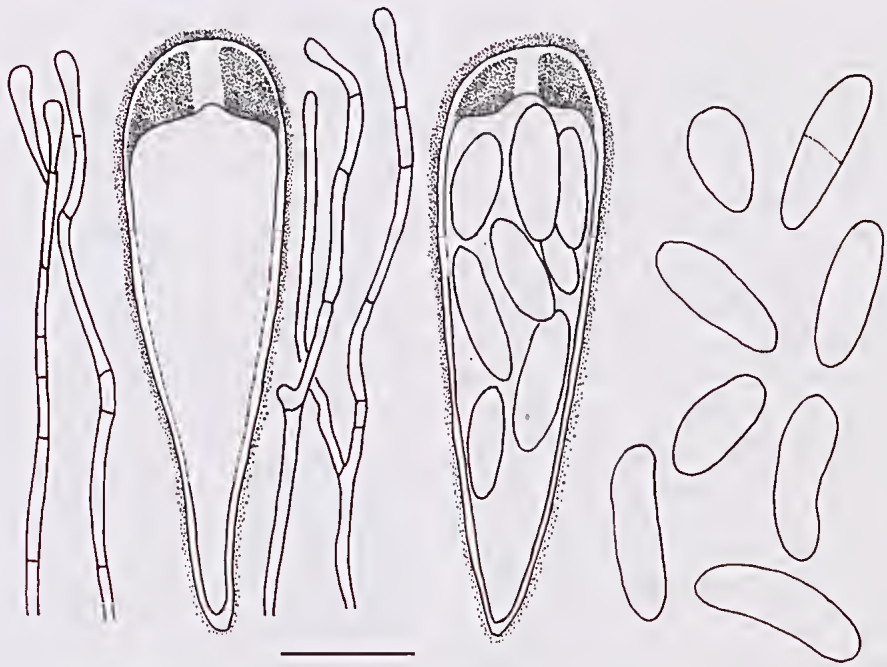

Figure. 1. *Lecanora subtecta* (*Kantvilas 132/06*, HO): asci with amyloid parts stippled, paraphyses and ascospores. Scale = 10 µm.

indistinct in water and KOH, with apices 1.5–2.5 µm thick, rarely (in the case of piebald apothecia) internally greenish pigmented. *Ascospores* hyaline, thin-walled, ovate to oblong-ellipsoid, rarely somewhat fabiform, simple but rarely with a plasma bridge and appearing spuriously 1-septate, 8–*11.7*–15 × 3–*4.4*–5(–5.5) µm. *Pycnidia* not observed. (Fig. 1)

Chemistry: usnic acid (major) and zeorin (major or minor), both detected by routine TLC; minor quantities of 2,5,7-trichloro-3-O-methylnorlichexanthone and isoarthothelin detected by HPLC.

Remarks: This tiny, inconspicuous lichen is best characterised by its yellow to orange, biatorine, ±immarginate apothecia that are usually densely covered with a coarse, vivid yellow pruina, the *Lecanora*-type asci and small, simple ascospores. In older apothecia, the pruina may become sparse or abraded, but some evidence of it can usually be detected with careful examination. Whilst clearly closely allied to *L. symmicta* as widely applied in the literature, that name (on the basis of the material examined and literature consulted) clearly has a very broad application. In our opinion, it makes little sense to broaden its definition still further to include a distinct Australian entity for which the valid name *L. subtecta* exists. Specimens examined of *L. symmicta* from the Northern Hemisphere differ most obviously by having more orange-brown to pinkish apothecia; where the apothecia are yellowish they nevertheless lack the vivid yellow pruina of *L. subtecta*. Similar pruina may be observed in the North American species *L. cupressi* Tuck., but that species differs from *L. subtecta* and *L. symmicta* by having apothecia with a thick, persistent thalline margin. Other characters of *L. symmicta*, such as ascospore size, thickness of paraphyses and thallus chemistry vary widely (on the basis of material examined and descriptions by Brodo *et al.* 2001; Hawksworth & Dalby 1992; Ryan *et al.* 2004; and Sliwa & Wetmore 2000) and simply emphasise the fact that a complex of taxa is involved.

Although we believe that *Lecanora subtecta* is a valid name for application in Australia, its re-instatement in no way resolves all the local problems within the *L. symmicta* group. There are several entities represented by Australian herbarium specimens that are not *L. subtecta* and must remain under the general label of '*L. symmicta* sensu lato' pending further study, a study that of necessity will involve examination of material from other parts of the world. For example, the descriptive data for *L. symmicta* in Australia provided by Lumbsch and Elix (2004) indicate that their concept does not include *L. subtecta*: the thallus contains usnic acid only, and the ascospores are longer and broader. The sole specimen of *L. subtecta* from mainland Australia (*Elix 38306*) has bright yellow, ±epruinose apothecia, and is included under *L. subtecta* with some misgivings. In Victoria, there is a taxon occurring on eucalypt lignin which has brownish to orange-brown epruinose apothecia, generally broader, ellipsoid ascospores (11–15 × 6–7 µm) and lacks substances detectable by TLC. From Queensland, also from eucalypt lignin, we have studied a taxon containing usnic acid and zeorin which has epruinose, yellow-orange apothecia with a persistent margin containing photobiont cells, and ascospores 10–16 × 3–4.5 µm. Also present in Tasmania is a minute species from *Nothofagus* twigs which has a very reduced to ±absent thallus (possibly containing traces of zeorin) and waxy, epruinose, yellow apothecia to 0.3 mm wide, with a persistent margin containing photobiont cells and ±globose ascospores, 7–9 × 6–7 µm; this taxon displays some similarities to *L. varia* (Hoffm.) Ach. from the Northern Hemisphere and to the widespread saxicolous species, *L. polytropa* (Hoffm.) Rabenh.

Past authors (e.g. Printzen & May 2002; Kantvilas & Elix 2007) have compared the *Lecanora symmicta* group to the genus *Ramboldia*. Certain characters of *L. subtecta*, such as the lignicolous habitat, the biatorine apothecia that become ±immarginate and the narrowly ellipsoid, relatively small ascospores, are reminiscent of *Ramboldia*, but there the similarities end. In the *L. symmicta* group, the asci have a distinctly cylindrical masse axiale with ±parallel flanks, whereas in *Ramboldia* the flanks of the masse axiale are divergent. The exciple of *Ramboldia* is far better differentiated and composed of densely-packed, radiating hyphae, whereas in *L. symmicta* it is relatively poorly differentiated and the constituent hyphae are loosely interwoven. Furthermore, the hymenium of *Ramboldia* species tends to be more lax in KOH, and it is generally overlain by a brownish epihymenial layer that becomes ±olive in KOH; nor are any species

of *Ramboldia* pruinose. Neither usnic acid nor zeorin, the diagnostic substances for the *L. symmicta* group, have been recorded in *Ramboldia*, which typically has a chemistry dominated by depsides and depsidones, or anthraquinone pigments (Kalb *et al.* 2008).

Distribution and ecology: This species is easily overlooked in the field, being tiny and growing in habitats that are generally depauperate or uninteresting for lichens, notably on eucalypt lignin. Stirton's type is from a piece of bleached wood, with *Ramboldia stuartii* (Hampe) Kantvilas & Elix and *Caloplaca* species. Most recent collections are from the cut surfaces of old eucalypt stumps in regenerating logging coupes. Here *Lecanora subtecta* is a member of a species-rich association of pioneer lichens which includes species of *Buellia* and *Caloplaca*, *Candelariella xanthostigmoides* (Müll. Arg.) R.W.Rogers, *Menegazzia subpertusa* P.James & D.J.Galloway, *Micarea intersociella* (Stirt.) Coppins, *Parmelina pseudorelicina* (Jatta) Kantvilas & Elix, *Ramboldia sorediata* Kalb, *Rinodina asperata* (Shirley) Kantvilas, *Trapeliopsis flexuosa* (Fr.) Coppins & P.James and *Usnea inermis* Motyka.

Specimens examined: **AUSTRALIA: TASMANIA.** c. 1.5 km N of Little Baldy, 41°45'S 147°56'E, 720 m alt., 17.v.1999, *G. Kantvilas 210/99* (HO); W of Tahune Bridge in the Warra SST, 43°06'S 146°41'E, 180 m alt., 23.v.2006, *G. Kantvilas 233/06* (BM, HO); same locality, *G. Kontvilas 132/06, 217/04, 156/06* (all HO); Loila Pinnacle, 41°25'S 148°11'E, 300 m alt., 1995, *F. Duncon s.n.* (HO). **NEW SOUTH WALES.** top swimming hole, Boonoo Boonoo Falls, 28°47'51"S 152°10'00"E, 4.v.2005, *J.A. Elix 38306* (CANB, HO).

Specimens of L. symmicta sens. lat. examined: **AUSTRALIA: VICTORIA.** Brighton, Jim Willis Reserve, 37°55'23"S 144°59'14"E, 6.vi.2006, *V. Stajsic 4061* pp (HO, MEL). **QUEENSLAND.** Bunya Mtns, Saddle Tree Creek, 26°52'S 151°32'E, 660 m alt., 24.xi.1995, *G. Kontvilas 179/95* (BRI, HO). **TASMANIA.** Yarlington Tier, 42°32'S 147°18'E, 620 m alt., 28.x.1987, *G. Kantvilos 144/87* (HO).

Comparative material of L. symmicta examined: **AUSTRIA: STEIERMARK.** Admonter Kaibling, 47°33'N 14°31'E, 2180 m alt., 23.viii.1990, *H. Moyrhofer & G. Kontvilos 549/90* (HO); Sparafeld, 47°33'N 14°31'E, 2240 m alt., 23.viii.1990, *H. Moyrhofer & G. Kontvilas 574/90* (HO); Pölzalm, 47°40'N 14°31'E, c. 760 m alt., 18.x.1994, *G. Böttger et al. s.n.* (HO). **CANADA: ONTARIO.** Dundas Co., 24.vii.1973, *P.Y. Wong 1231* (CANL). **ITALY:** Vincenza, Sett Comuni, 45°58'N 11°29'E, 1835 m alt., *G. Rambold 2742* (*H. Hertel: Lecideaceae Exsicc.* 244) (HO). **GERMANY: RHEINLAND-PFALZ.** Eifel, 08.v.1997, *H.T. Lumbsch & G.B. Feige Lec. Lich. Exs. no. 93* (BM); **UNITED KINGDOM: ENGLAND: YORKSHIRE.** near Easby, 1835, *J. Ward s.n.* (BM, barcode no. BM000763883). **UNITED STATES OF AMERICA: MAINE.** Knox Co., Rockland, 10.x.1909, *G.K. Merrill's Lich. Exs. no. 115* (BM, FH); **MASSACHUSETTS.** Worcester Co., Princeton, Wachusett Mountain, 11.vii.1997, *P. May 3379* (FH).

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Pigment chemistry and morphology support recognition of *Cortinarius austrocinnabarinus sp. nov.* (Fungi: Cortinariaceae) from Australia

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Introduction

The late Melvyn Gill (1946-2004) (Burns *et al.* 2005) and co-workers carried out extensive research on the pigment chemistry of Australian macrofungi, especially on anthraquinones from the basidiomycete genus *Cortinarius* (Pers.) Gray (Gill 1995, 2001). One of the groups of pigments discovered contained novel anthraquinones (including austrocorticin) based on a propionate-triggered octaketide assembly, in contrast to the more usual acetate-primed biosynthesis (Gill & Giménez 1988). Many of the collections investigated by Gill were not identified to species at the time, due to the lack of monographic treatments of the genera concerned. The material from which austrocorticin was isolated (*Watling 19352* in E) was indicated by Gill and Giménez (1988) as belonging to a 'new taxon' in *Cortinarius* subgenus *Dermocybe* (Fr.) Loudon. Gill and Giménez (1988) further noted that the fungus was the same as that 'wrongly' illustrated under the name *Cortinarius cinnabarinus* Fr. by Cole *et al.* (1978) and Fuhrer (1985).

Cortinarius cinnabarinus, a species originally described from Europe, was placed by Moser (1974) and earlier workers in *Cortinarius* subgenus *Dermocybe* due to the presence of anthraquinone pigments. However, on the basis of pigment chemistry, morphology, cytology and ecology, Høiland (1983) proposed that a more appropriate placement for *C. cinnabarinus* was alongside *Cortinarius bulliardii* (Pers.: Fr.) Fr. in section *Armillati* Moser, within subgenus *Telamonia* (Fr.) Loudon, and molecular data confirm this placement (Garnica *et al.* 2005). A second species, *C. californicus* A.H.Sm., is considered to be close to *C. cinnabarinus* based on morphology and pigment profile (Keller 1982; Høiland 1983; Keller & Ammirati 1983; Ammirati 1989; Høiland & Holst-Jensen 2000). In various studies based upon DNA sequence data (Liu *et al.* 1997; Chambers *et al.* 1999; Høiland & Holst-Jensen 2000; Seidl 2000), *C.*

Abstract

Cortinarius austrocinnabarinus R.H.Jones & T.W.May *sp. nov.* is proposed to accommodate Australian collections previously assigned to either *Cortinarius cinnabarinus* or *Dermocybe cramesina*. Among these collections is the voucher from which novel anthraquinone pigments, including austrocorticin, were initially isolated. The presence in Australia of *Cortinarius cramesinus comb. nov.* is confirmed. Thin-layer chromatography patterns differ significantly between *C. austrocinnabarinus* and *C. cramesinus*, and there are also macro- and micro-morphological differences.

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californicus is placed in a clade with other members of subgenus *Telamonia* outside subgenus *Dermocybe*. Thus, there would appear to be at least two distinct groups within *Cortinarius* in which a range of species produce anthraquinone pigments.

The image reproduced under *Cortinarius cinnabarinus* in Fuhrer (1985) was included in a later reprinting of *The Field Companion to Australian Fungi* (Fuhrer 1993) captioned *Dermocybe cramesina* E.Horak. Horak (1988) described *D. cramesina* from New Zealand, with a 'cinnabar red or crimson red' pileus. However, Gill (1995) and Morgan (1998) examined pigment extracts from the type collection of *D. cramesina* by thin-layer chromatography, and found that there were no features in common with extracts from the Australian material designated as *C. cinnabarinus* (*Watling 19352* in E) from which austrocorticin and related compounds had been isolated.

Pigment chemistry, molecular data, morphology and ecology were incorporated in a comprehensive investigation of Australian species of *Cortinarius* subgenus *Dermocybe* and other *Dermocybe*-like members of *Cortinarius* (Jones 2003). On the basis of that study, plus evidence from published work on pigment chemistry (e.g. Gill & Giménez 1988; Gill 1995; Morgan 1998), we propose a new species for Australian material previously misidentified as *Cortinarius cinnabarinus* or incorrectly assigned to *Dermocybe cramesina*, and also confirm the occurrence of *C. cramesinus* in Australia.

Materials and Methods

Morphology

Macroscopic information was recorded from fresh material collected from areas of natural vegetation in Victoria and southwest Tasmania. The *Methuen Handbook of Colour* (Kornerup & Wanscher 1978) was used to record basidiome colour from fresh material prior to air-drying collections using a Hydraflow Ezidri Ultra 1000 dehydrator. Collections are lodged at MEL. Representatives from herbarium collections of mainly Australian material on loan from CSIRO–Wembley, E, MEL, and ZT were also examined, as were collections provided by D.A. Ratkowsky and G. Gates (Tasmania) and K. Syme (Western Australia).

Data on microscopic characters were recorded from dried material rehydrated in 3% aqueous KOH (w/v). Following initial examination, 0.5% aqueous Congo Red (w/v) was added to these preparations to enhance contrast. Radial sections through the pileipellis were initially observed in water. Drops of 3% KOH were then added to the slide at the edge of the cover slip, and the KOH drawn under the slide by placing absorbent paper on the other side of the cover slip. Data on spores and basidia were taken from lamellae fragments of mature basidiomes. The designation A/B in square brackets before spore measurement data indicates A measurements from B collections. At least ten spores were measured from one or more basidiomes of each collection. Spore measurements were to the nearest 0.5 µm and excluded ornamentation and the hilar appendage. The spore quotient (Q) for an individual spore is the spore length divided by the spore width. For each collection the mean values for spore length, spore width and spore quotient were calculated, and the range of means across collections is presented along with the grand mean across the means from each collection. Basidia measurements did not include sterigmata.

The ornamentation of spores was examined using Scanning Electron Microscopy (SEM). Air-dried spores taken from lamellae fragments of mature basidiomes were settled onto adhesive carbon tabs (Proscitech, Thuringowa, Qld) on the upper surface of 12 mm diameter stubs. Stubs were coated with gold using an Edwards S150B sputter coater (Dynavac, Bayswater, Victoria) and examined using a Philips XL30 FEG Field Emission Scanning Electron Microscope operated at 5.0 kV.

Pigment chemistry

Methanolic pigment extracts were evaporated to dryness under gaseous nitrogen. Extract residues were reconstituted with a minimal amount of dichloromethane. Reconstituted extracts were subjected to thin-layer chromatography (TLC) on POLYGRAM SIL G/UV254 pre-coated plastic, 10 × 20 cm plates with a silica layer thickness of 0.25 mm. A standard extract of *C. persplendidus* Gasparini (synonym *Dermocybe splendida* E.Horak), a species whose major pigments have been identified (Elsworth *et al.* 1999; Gill & Smrdel 2000), was included on each plate. TLC plates were developed at room temperature

in a standard TLC chamber. The mobile phase solvent consisted of toluene:ethyl formate:formic acid at a ratio of 50:49:1, prepared in 500 ml batches and stored at room temperature. Saturation of the chamber was achieved by adding 50 ml of eluent to the chamber at least half an hour prior to the development of a plate. The R_f factor (Relative to Front) for each pigment band was calculated by dividing the distance moved by the band (measured from the middle of the band) by the distance moved by the solvent front.

It is well known in literature on thin-layer chromatography (e.g. Kidd *et al.* 1985) that the R_f of a given band may vary from one run to another. Taking this into account in a taxonomic study utilising TLC with numerous collections of Australian *Cortinarius*, Jones (2003) carried out a series of preliminary TLC runs in which samples of unknown extracts were run in various combinations. Extracts showing similar profiles were then run together on the same plate. Samples of putative taxa in the present study were thus eventually

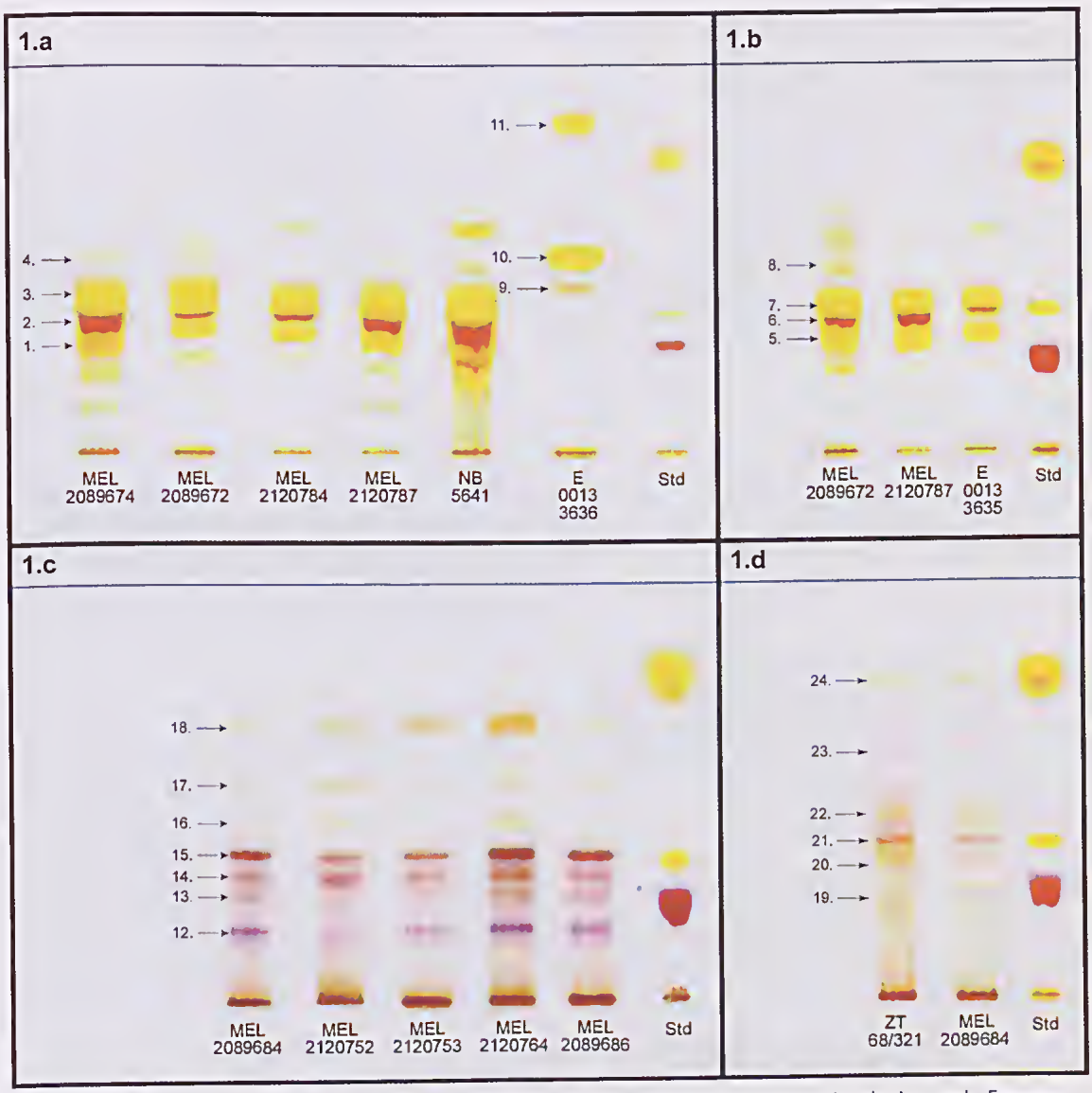

Figure 1. Thin layer chromatography plates for pigment extracts. (a and b) *Cortinarius austrocinnabarinus* and a European collection of *C. cinnabarinus* (E 133636), (d and e) *C. cramesinus*, including the type (ZT 68/321)from New Zealand. The blue line indicates the solvent front. Std denotes the standard extract from *C. persplendidus*.

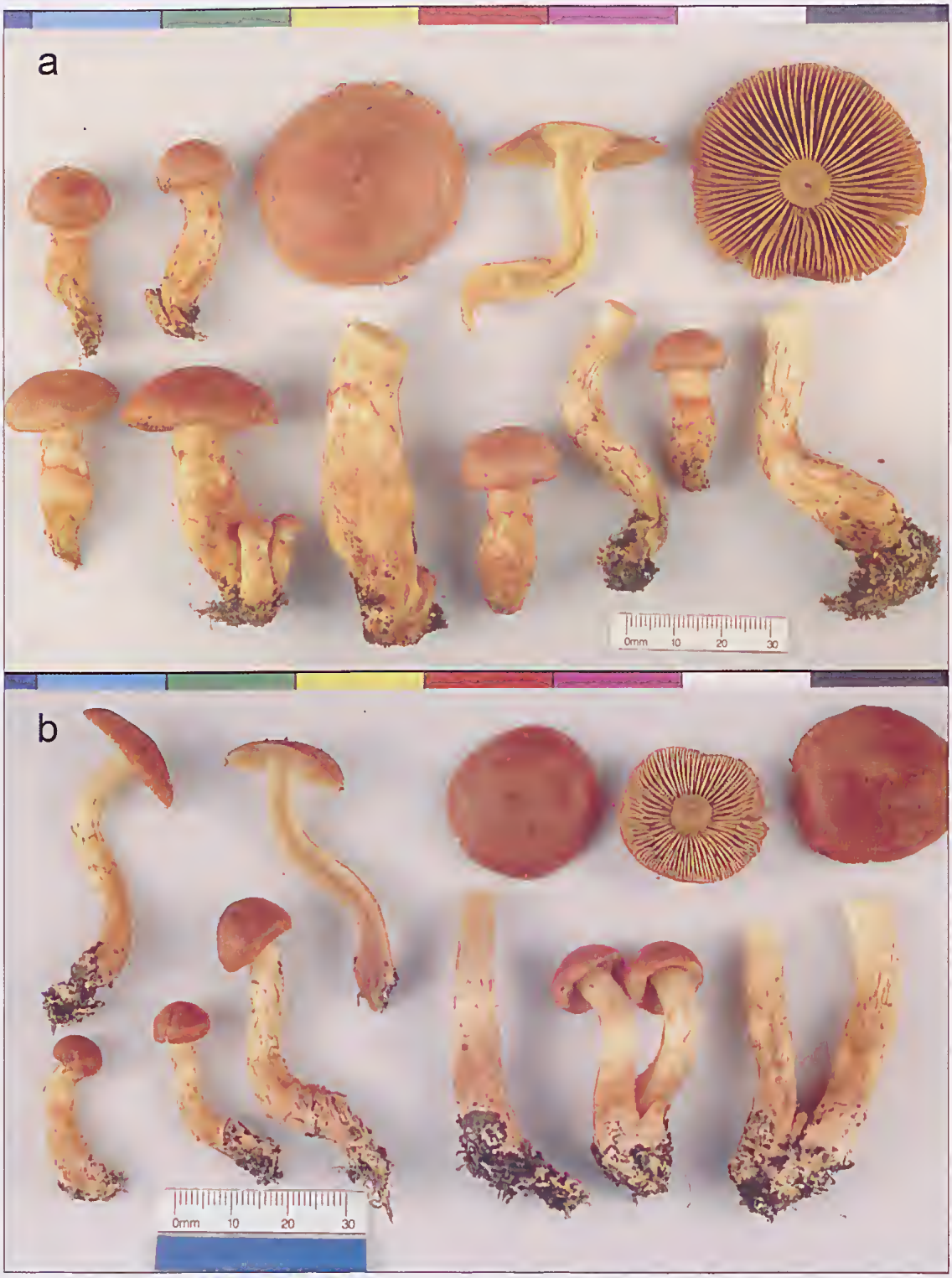

Figure 2. Basidiomes. (a) *Cortinarius austrocinnabarinus* (MEL 2089672), (b) *C. cramesinus* (MEL 2089686). Scale bar = 30 mm.

run together on individual plates, with the exception of the voucher *Watling 19352* (from Gill & Giménez 1988) and the type of *Dermocybe cramesina* for which the small amount of extract available precluded numerous runs. R_f values quoted in the text refer to the particular plate being discussed. Each distinct band on each TLC plate is numbered in bold. Results of chromatographic analyses are presented separately for each TLC plate. Some lanes have been deleted for illustrative purposes.

Results

Pigment chemistry

Two distinct patterns were observed (Fig. 1). In the first pattern (Fig. 1a) there was an orange band [**1**] (yellowish in profiles from more dilute extracts) at R_f =0.27–0.30, which abutted a red band [**2**] at R_f =0.32–0.33, which abutted a strong and broad yellow band [**3**] at R_f =0.40. A faint pinkish yellow band [**4**] at R_f =0.49 is barely visible in all profiles except MEL 2120784. Weaker bands included a faint yellow band, visible just above the baseline in the profiles from more concentrated extracts, as well as some faster migrating yellow bands. An extract from the voucher *Watling 19352* (E 133635), cited by Gill and Giménez (1988) in their studies of austrocorticin, was run on a separate plate (Fig. 1b), along with MEL 2120787 and MEL 2089672. The profiles had an orange/yellowish band [**5**] at R_f =0.27–0.30, a red band [**6**] at R_f =0.32–0.33, and a yellow band [**7**] at R_f =0.40. The profile of MEL 2089672 also had a pinkish yellow band [**8**] at R_f =0.49. The major bands [**5,6,7,8**] of the samples run on the second plate (fig. 1b) corresponded very well to the major bands [**1,2,3,4**] in Figure 1a.

In the profile of a Danish collection (E 133636) of *C. cinnabarinus* (Fig. 1a) included in the study, the three visible bands were a pink band [**9**] at R_f =0.42 below a strong and broad yellow band [**10**] at R_f =0.51, and a fast migrating yellow band [**11**] at R_f =0.85. These bands did not match up to bands present in the first pattern described above, nor with profiles of the second pattern described below.

In the second pattern (Fig. 1c), all the main bands from the first pattern were absent. Figure 1c shows a slower migrating purple band [**12**] at R_f =0.17, with three evenly spaced brownish red bands [**13, 14, 15**] at R_f =0.25, 0.29 and 0.35 above. Band [**13**] is indistinct for the more dilute profiles of MEL 2120752 and MEL 2120753. In addition there were three greyish brown bands [**16, 17, 18**] at R_f =0.43, 0.52 and 0.66, appearing at various levels of density over the five profiles. The overall pigment pattern was almost identical across the five collections.

A relatively dilute extract from the type of *D. cramesina* from New Zealand (ZT 68/321) was compared on a separate plate (Fig. 1d) against a similarly dilute extract from one of the collections (MEL 2089684) that had the second pattern. The profile of the *D. cramesina* type showed a number of points of similarity to MEL 2089684, sharing a weak purplish band [**19**] at R_f =0.23. A brownish pink band [**20**] at R_f =0.31 is weak in ZT 68/321 but distinct in the profile of MEL 2089684, below a brownish red band [**21**] at R_f =0.36. With minor differences in colour and intensity, these three bands [**19, 20, 21**] are considered to correspond to, respectively, the lower purple band [**12**] and the upper two reddish brown bands [**14, 15**] in Figure 1c. Immediately above the group of major bands in Figure 1d there was a greyish brown band [**22**] at R_f =0.44. Both profiles share a fast migrating weak pinkish mauve band [**23**] at R_f 0.60; in ZT 68/321 this band blurs upwards, and is preceded by a mauve band. A fast migrating, extremely faint yellow band [**24**] at R_f=0.76 was also shared by both profiles.

Taxonomy

The two distinct chromatographic patterns correlated well with differences in macro- and micro-morphological characters of the collections examined. Two taxa, *C. austrocinnabarinus* and *C. cramesinus*, are recognised.

1. *Cortinarius austrocinnabarinus* R.H.Jones & T.W.May *sp. nov.*

Cortinarius cinnabarinus sensu Australian authors; *Dermocybe cramesina sensu* Fuhrer (1993; 2001; 2005); *D.* sp. *Watling 19352 sensu* Gill (1995).

A C. cinnabarino *sporis parvioribus, 5.5–7.5(–8.5) × 4–6 µm, pilei infirme hygrophani et austrocorticino praesenti differt.*

***Type*: AUSTRALIA: VICTORIA**. Kinglake NP, NW of intersection Melba H'way with Kinglake–Toolangi Rd, 30.vi.1985, *T.W. May B365 & B.A. Fuhrer* (holotype: MEL 2120784).

Pileus 17–55(–85) mm diam., hemispherical or conico-convex when young, becoming convex to plano-convex or subumbonate, often eventually broadly undulating towards edge, rarely upturned; deep orange red to red (8–9)(A–C)(7–8), becoming pastel red 7(A–B)5 on outer pileus towards maturity, sometimes the outer pileus colour fades at maturity leaving disc area darker, and pileus surface colour slightly patchy; surface dry; coarsely felty fibrillose, especially when young, more radially so on outer pileus; reddish orange universal veil remnants forming radial to subradial aggregations becoming sparse towards maturity, sometimes forming minute appressed scales, sometimes with veil remnants remaining attached to margin; weakly hygrophanous, not translucent-striate; margin sometimes exceeding lamellae, slightly inflexed when young, becoming straight, rarely recurved, entire to minutely eroded or rimose at maturity. *Lamellae* sinuate or occasionally adnexed; to 12 mm deep; moderately crowded; initially yellowish orange 5(A–B)(7–8), becoming brownish orange to reddish orange (6–7)(B–C)(7–8); edge entire, rarely irregularly denticulate or finely eroded, concolourous or occasionally blotchy, discolourous to darker red, especially at maturity. *Stipe* 34–87 mm long, 5.5–17 mm diam. at middle, to 20 mm diam. at widest part, cylindrical or attenuated upwards, often subfusoid and rapidly attenuated downwards towards base; upper stipe light yellow to pale orange (4–6)A4, lower stipe appearing more reddish orange or yellowish red (7–8)A(7–8), often in zones of colour; surface dry; longitudinally fibrillose; sometimes rusty brown arachnoid cortina remnants on upper stipe of young specimens; orange red veil remnants forming fine to moderately coarse longitudinal aggregations, occasionally forming distinct subdowny bands, or a dense subdowny covering over large areas of the stipe surface of young specimens, otherwise aggregations becoming more dense on mid stipe, forming distinct bands or zones, often becoming more coarse on lower stipe; base with fine yellowish or pinkish orange downy covering, grading into coarser basal mycelium with bright orange rhizomorphs. *Context* in pileus, to 4 mm deep; pallid yellowish brown in disc area, more orange brown towards edge; in stipe, pallid pale yellowish orange to yellowish brown. *Odour* weakly spicy or chemical. *Chemical reactions* 3% KOH on pileus, rapid, strong, deep purple; on stipe, rapid, strong, purple; lamellae tissue in KOH solution leaching faint yellow to yellowish brown pigment. (Fig. 2a)

Basidiospores [285/12] 5.5–7.5(–8.5) × 4–6 µm, mean 6.27–7.36 × 4.67–5.45 µm (grand mean 6.74 × 4.93 µm), Q = (1.09–)1.25–1.56(-1.78), mean Q = 1.22–1.52 (grand mean 1.37), broadly ellipsoid to ellipsoid, occasionally elongate, amygdaliform or broadly amygdaliform; yellow-brown; ornamentation finely to moderately verrucose, the verrucae sparse to moderately dense, under SEM verrucae isolated and relatively rounded. Basidia 27–37 × 6.5–7.5(–9) µm, clavate, four or rarely two-spored, sterigmata to 4 µm long. *Cheilocystidia*

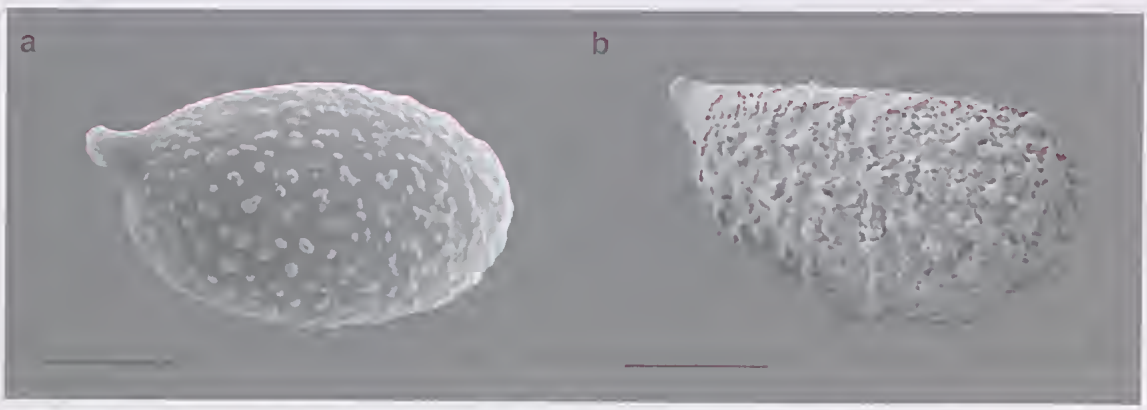

Figure 3. Scanning electron micrographs of spores. (a) *Cortinarius austrocinnabarinus* (MEL 2089672), (b) *C. cramesinus* (ZT 68/321, holotype). Scale bar = 2 µm.

and *Pleurocystidia* not present. *Lamellar trama* regular. *Pileipellis* a cutis or trichoderm consisting of repent, and often also some loosely interwoven and ascending, cylindrical, encrusted hyphae 4–8 µm diam., with yellow intracellular pigment (in KOH releasing bright purple pigment); with a differentiated subcellular subpellis, consisting of broader, short hyphae to 32 µm diam., with amorphous bright orange intercellular pigment masses (in KOH wine red). *Clamp connections* present in all tissues. (Figs 3a, 4a)

***Specimens examined*: AUSTRALIA: TASMANIA.** 5outhwest Tasmania NP, The Wedge Forest Reserve, 15.iv.2000, *G. Gotes & D. Rotkowsky (R.H. Jones 104)* (MEL 2314611); **VICTORIA.** Kinglake NP, Island Ck Picnic Area, 5tringybark Tk near junction of Andrews Hill West Tk, 27.vii.1999, *R.H. Jones 80 & N. Polikorpowski* (MEL 2314610); Kinglake NP, Island Ck Picnic Area, Stringybark Tk near junction of Andrews Hill West Tk, 7.vii.2000, *R.H. Jones 154 & K. 8eottie* (MEL 2314613); Narbethong–Marysville Road, 3.5 km NE Narbethong, Old Coach Rd turnoff, 25.vi.2000, *R.H. Jones 150* (MEL 2089672); Kinglake Junction, 2.vi.1984, *8.A. Fuhrer 899* (MEL 2052786); Kinglake NP, NW of intersection Melba H'way with Kinglake–Toolangi Rd, 19.vi.1986, *T.W. May B384 & 8.A. Fuhrer* (MEL 2192221; duplicate is *Wot.[ling] 19352* in E 133635, as 'Kinglake, coll. M. Gill [sic], *T. Moy 8384*, July [sic.] 1986'); same locality, 22.vi.1986, *8.A. Fuhrer 1125* (MEL 2053344); Buninyong, Union Jack Reserve, 21.vii.2000, *R.H. Jones 167 & 8. Andrews* (MEL 2089674); 21.vii.2000, *R.H. Jones 168 & 8. Andrews*, (MEL 2314614); Wombat SF, Blakeville–Bunding Rd, 500 m from Daylesford–Ballan Rd, 100 m N Blakeville–Bunding Rd, 9.vii.2000, *R.H. Jones 155 & Field Noturolists Club of 8ollorot* (MEL 2089673); **WESTERN AUSTRALIA.** Dwellingup, Plavins Forest Block, off Murray River Rd, 9.vii.1996, *N.L. Bougher* E5641 (PERTH, ex C5IRO–Wembley); Walpole, Lochart Forest Block, W of Thompson Rd, 5.vi.2000, *K. Syme 1055/00* (MEL 2120787; PERTH).

***Additional material examined*:** *Cortinorius cinnoborinus.* **DENMARK.** Copenhagen, 22.ix.1980, *collector illegible (Roy Wotling 13716)* (E 133636).

***Habitat*:** Gregarious or often caespitose on soil in *Eucalyptus* dominated forest, often including *Leptospermum* spp.

***Coloured illustrations*:** The following cited illustrations are likely to represent *Cortinarius austrocinnabarinus*: Cole *et al.* (1978: pl. 2, as *C. cinnabarinus* [photo is by Fuhrer]), Fuhrer (1985: p. 33, as *C.* aff. *cinnabarinus*; 1993: p. 33, as *D. cramesina* [see errata slip]; 2001: p. 33, as *D. cramesina*; 2005: p. 61, as *D. cramesina*), Gill (1995: p. 2, as *Dermocybe* sp. *Watling 19352* [photo is by Fuhrer, but not a photograph of this particular collection]) and McCann (2003: p. 21, as *D. cramesina*). In the illustration of *C. cinnabarinus* in Willis (1963: pl. 9) the pileus is a little too red, and the uniform deep reddish orange colour of the stipe is also not consistent with *C. austrocinnabarinus*. Voucher material specific to particular illustrations is not available to confirm identification, but note that several *Fuhrer* collections at MEL originally determined as *C. cinnabarinus* or *D. cramesina* are listed above under 'Specimens examined'.

***Notes*:** Among Australian species of *Cortinarius* subgenus *Dermocybe* and other *Dermocybe*-like members of *Cortinarius* (see Jones 2003), *Cortinarius austrocinnabarinus* is characterised by the strong orange-red colour to the pileus, that often fades to pastel orange-red on the outer pileus at maturity, and the relatively small spores that are broadly ellipsoid to ellipsoid. The habit is often caespitose, and there are characteristically distinct bands or zones of coarse, orange-red veil remnants on the mid to lower stipe. Young basidiomes can be relatively squat, with the unexpanded pileus seated on a short, broad stipe. A unique feature associated with this taxon is the brownish orange colouration remaining on fingertips after the handling of basidiomes.

In addition to the distinct differences between pigment profiles for *C. austrocinnabarinus* and *C. cramesinus* discussed above, *C. austrocinnabarinus* can be distinguished from *C. cramesinus* by the pilei of *C. austrocinnabarinus* often developing a washed-out orange colour by maturity, whereas the orange colour in pilei of *C. cramesinus* is less intense at maturity, and is usually restricted to the margin of an often browner coloured pileus. Dried material of *C. austrocinnabarinus* retains a strong orange colouration in the pileus, whereas dried material of *C. cramesinus* is a dark vinaceous brown without orange tints to the pileus. The orange red veil remnants of *C. austrocinnabarinus* usually form coarser longitudinal and band-like aggregations on the stipe than do those of *C. cramesinus*, which has a pinkish basal mycelium (remaining visible in dried material) rather than the orange red mycelium of *C. austrocinnabarinus*. Spores of *C. cramesinus* are about the same length as those

of *C. austrocinnabarinus*, but are slightly narrower, and hence tend to be more often elongate than ellipsoid. Under SEM the verrucae of *C. austrocinnabarinus* are relatively rounded and isolated , whereas verrucae of *C. cramesinus* are more irregular in shape, with some interconnections (Fig. 3).

The identity of material from which austrocorticin and related pigments were isolated by Gill and Giménez (1988) has been confirmed as *C. austrocinnabarinus* by examination of the voucher material cited therein (collected from the type locality). The principal anthraquinones of *C. austrocinnabarinus* are austrocorticin, austrocorticinic acid and austrocorticone (Gill 1995). These compounds are the only naturally occurring quinones of the emodin/endocrocin type that have a two carbon side chain at the position C3. They are unique among anthraquinones from *Cortinarius* in having a propionate-triggered octaketide assembly (Gill & Giménez 1988).

The pileus colour of *Cortinarius austrocinnabarinus* is similar to the dark cinnabar-red to scarlet colouration of the European *C. cinnabarinus*, and the two species also share the presence of a subcellular subpellis (Høiland 1983). However, the latter species differs in the hygrophanous pileus and the larger spores up to 10 µm long (Høiland 1983), and in containing different major pigments, such as cinnarubin and fallacinol (Keller 1982), reflected in the different pigment profile (Fig. 1a). The North American counterpart of *C. cinnabarinus* is *C. californicus*, which differs from *C. austrocinnabarinus* by the reddish brown or dark reddish orange pileus that is hygrophanous, the longer spores, (7.4–)8–9.5(–11) µm, the association with conifers (Ammirati 1989), and in having cinnarubin as its major pigment (Keller & Ammirati 1983). *Cortinarius hesleri* Ammirati & A.H.Sm. *nom. prov.*, a name used for a collection from North America similar to *C. californicus*, but associated with broad-leaved trees (Phillips 1991), also has cinnarubin as the major pigment (Keller & Ammirati 1983).

2. *Cortinarius cramesinus* (E.Horak) R.H.Jones & T.W.May, *comb. nov.*

BASIONYM: *Dermocybe cramesina* E.Horak *Sydowia* 40: 87 (1988).

In consideration of the perceived immaturity of the single collection on which the protologue is based, the following description is derived from characters of Australian collections, unless otherwise indicated.

Pileus to 50 mm diam., hemispherical or obtusely conical when young, becoming convex to plano-convex, occasionally with slightly undulating edge at maturity; orange red to brownish red 8(B–D)(6–7), sometimes more orange 7B7, edge often brighter orange (7–8)A(5–7); surface dry; felty fibrillose when young, becoming more radially fibrillose, often with fine radial aggregations of veil remnants, sometimes with minute appressed scales on mature specimens; rarely subhygrophanous, not translucent-striate; margin straight or occasionally inflexed, entire or occasionally finely rimose at maturity. *Lamellae* sinuate to narrowly adnate; to 5 mm deep; brownish orange (5–6)(B–C)(6–8); edge entire, rarely finely eroded towards distal part. *Stipe* to 80 mm long, to 8 mm diam. at middle, to 11 mm diam. at widest part, cylindrical or slightly attenuated

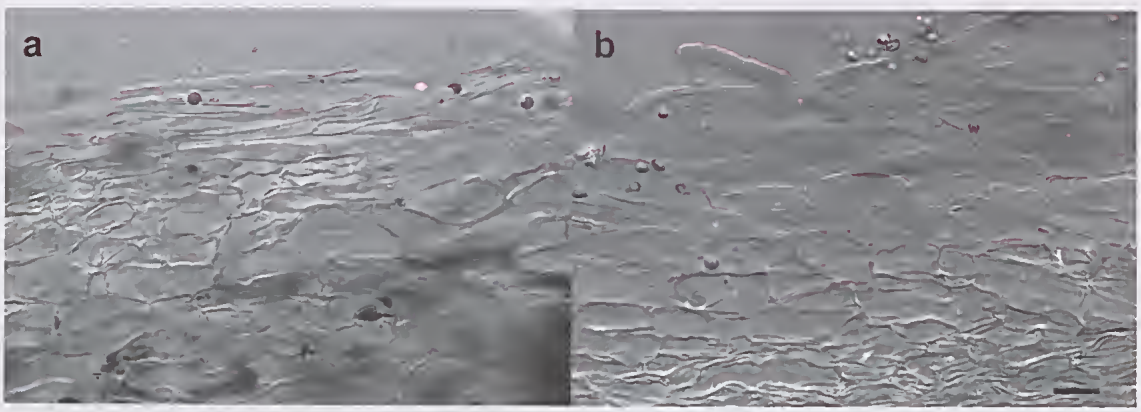

Figure 4. Pileipellis in cross section, mounted in 3% KOH. (a) *Cortinarius oustrocinnabarinus* (MEL 2089673), (b) *C. cramesinus* (MEL 2089684). Scale bar = 20 µm.

upwards, often with finely subbulbous base; pale or light orange (5–6)A(3–4) upper stipe, to orange red (7–8)A(5–7) or sometimes more vivid (8–9)A(7–8) on lower stipe; surface dry; finely longitudinally fibrillose; cortina remnants sometimes forming an indistinct rusty brown band near stipe apex of younger specimens, not apparent on more mature specimens; orange red or brownish red veil remnants forming fine longitudinal to sublongitudinal aggregations, sometimes forming an indistinct band on upper to mid stipe, rarely with less distinct bands below, aggregations usually becoming denser and more arachnoid on lower stipe; basal area usually with pale pink or orange pink downy covering; basal mycelium orange pink. *Context* in pileus, to 2 mm deep, pallid yellow brown; in stipe, pallid yellow brown. *Chemical reactions* 3% KOH on pileus, rapid, strong, blackish purple; on stipe, rapid, strong, reddish purple; lamellae tissue in KOH solution leaching faint light brown pigment. (Fig. 2b)

Basidiospores [120/6] 5.5–8.5(–10) × 3.5-5.5 µm, mean 5.80–8.15 × 3.90–4.90 µm (grand mean 7.36 × 4.53 µm), Q = (1.38–)1.44–1.80(–2.00), mean = 1.49–1.68 (grand mean 1.62) [in the type, 6–7.5 × 4–5 µm, Q = 1.44–1.56(-1.67) µm, mean = 6.7 × 4.5, mean Q = 1.49], ellipsoid to elongate, narrowly amygdaliform to amygdaliform; yellow-brown; ornamentation finely verrucose, verrucae moderately dense to dense, under SEM the verrucae are irregular in shape and show some interconnections. *Basidia* 27–32 × 6–7.5 µm, narrowly clavate, four-spored, sterigmata to 5 µm long. *Cheilocystidia* and *Pleurocystidia* not present. *Lamellar* trama regular. *Pileipellis* a cutis or trichoderm consisting of repent or ascending (and then often in bundles), cylindrical, non-encrusted hyphae 6-14 µm diam., with pinkish grey or pale orange intracellular pigment (in KOH greyish purple to strongly vinaceous or reddish purple); with a differentiated subcellular subpellis, consisting of broad, short hyphae, to 31 µm diam., pale orange in mass or with orange intracellular pigment globules (in KOH purple). *Clamp connections* present in all tissues. (Figs 3b, 4b)

***Specimens examined*: NEW ZEALAND: NELSON.** Lake Rotoiti, trail to St Arnaud Range, 30.iv.1968, *E. Horak*, ZT 68/321 (isotype); **AUSTRALIA: VICTORIA.** Kinglake NP, Island Ck Picnic Area, 7.vi.1999, *R.H. Jones 53* (MEL 2089684); Kinglake NP, Masons Falls Picnic Area, 9.vi.2000, *R.H. Jones 132* (MEL 2120764); Wombat SF, Old Farm Rd, Werribee Tk, 4.vii.1999, *R.H. Jones 73* (MEL 2120752); Wombat SF, McCarthy Rd near Squires Ck turnoff, 4.vii.1999, *R.H. Jones 74* (MEL 2120753); Wombat SF, Wombat–Barkstead Rd, 4 km from Barkstead, 300 m from road, 16.vi.2000, *R.H. Jones 140* (MEL 2089686).

***Habitat*:** In Australia gregarious on soil of *Eucalyptus* dominated forest; in New Zealand under *Nothofagus fusca* and *N. menziesii*.

***Notes*:** Australian material is more robust (pileus to 50 mm diam., stipe to 65 mm long, to 8 mm diam. at middle, to 11 mm diam. at widest part) than the single collection from New Zealand (pileus to 30 mm diam., stipe to 50 mm long, to 4 mm diam.). Also, the pileus surface and lower stipe fibres are not as brightly coloured as in the New Zealand collection, in which they are 'cinnabar red or crimson red' (Horak 1988). Based on appearance of the type material obtained for inclusion in this study, it is possible that the New Zealand collection was immature, and hence smaller and with the colour more concentrated in the pileus and lower stipe. In other respects, including spore size and shape and the structure and pigmentation of the pileipellis, the Australian material conforms to the protologue.

There is sufficient similarity in pigment profiles of the type material and Australian material to suggest that it is prudent to assign the Australian collections to *C. cramesinus*. Differences between the pigment profiles of the *C. cramesina* type and the Australian collections are within the range of variation observed in other species (Jones 2003). Further collections of *C. cramesinus* from New Zealand are desirable in order to further investigate variation in basidiome colour and pigment chemistry within the species.

Analyses based on molecular data suggest that a new combination in *Cortinarius* for *Dermocybe cramesina* is necessary. In molecular analyses, most species formerly placed in *Dermocybe* are placed either in a clade containing only species of *Dermocybe* that is nested within a larger *Cortinarius* clade (Chambers *et al.* 1999; Høiland & Holst-Jensen 2000; Seidl 2000; Peintner *et al.* 2001, 2004; Garnica *et al.* 2005) or, in relatively few cases such as for *C. californicus* and *C. cinnabarinus*, are placed outside *Dermocybe sens. strict.* but remain within the broader *Cortinarius* clade (Høiland & Holst-Jensen 2000; Seidl 2000; Garnica *et al.* 2005). The relationships of New Zealand species assigned to *Dermocybe* by Horak (1988) have not yet been established from molecular data.

Discussion

Data presented here confirm the finding of Gill (1995) and Morgan (1988) that the pigment pattern of *C. austrocinnabarinus* is quite distinct from that of *C. cinnabarinus* and *C. cramesinus*. In addition, none of the other species of Australian *Cortinarius* that were examined by Jones (2003) had similar pigment profiles to either *C. austrocinnabarinus* or *C. cramesinus*.

Cortinarius cinnabarinus is one of a growing number of species of ectomycorrhizal agarics originally described from Europe, now shown to have been erroneously reported from Australia (or to only occur there as exotics). For example, in *Cortinarius*, Gasparini (2001) described *Cortinarius austroviolaceus* Gasparini for Australian material previously identified as the Northern Hemisphere *C. violaceus* (L.) Gray; in *Russula* Pers., Grgurinovic (1997) considered that the collections that had been assigned by Cleland (1934) to six Northern Hemisphere species belonged in fact to independent species, newly typified on Australian material; and in *Laccaria* Berk. & Broome, May (1997) found that all collections previously assigned to *Laccaria laccata* (Scop. : Fr.) Cooke were erroneously identified, and this particular species occurred in Australia under exotic *Quercus* only. The presence of seemingly identical taxa from the Northern and Southern Hemispheres has complicated the naming of austral fungi, but it is now a reasonable assumption that austral ectomycorrhizal taxa are distinct from those of the Northern Hemisphere.

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A new species and a new combination in the shining peppermint group of *Eucalyptus* and notes on the distribution of *Eucalyptus willisii sens. strict.*

ex 241 631

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Abstract

Populations of shining peppermints in *Eucolyptus* Series *Rodiatoe* Chippend. occurring adjacent to the Gippsland Lakes region are described as a new species, *Eucolyptus orenicolo* K.Rule. As well, populations of shining peppermints referred to as *E. willisii* subsp. *folciformis* Newnham, P.Ladiges & Whiffin are elevated to the rank of species as *Eucolyptus falciformis* (Newnham, Ladiges & Whiffin) K.Rule. *Eucolyptus folciformis* includes both populations of the Grampian Ranges and those of coastal and sub-coastal areas of south-west Victoria and adjacent areas of South Australia. Also discussed are the affinities, ecologies, distributions and conservation statuses of the new species and the new combination. Further, notes clarifying the distribution of *Eucolyptus willisii* Ladiges, Humphries & Brooker are given.

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Introduction

The names 'shining peppermint' and 'shiny-leaved peppermint' have been applied to a loose grouping of south-eastern Australian and Tasmanian peppermint eucalypts with somewhat lustrous, coriaceous adult leaves and smallish, thick-walled fruits (Willis 1970; Newnham *et al.* 1986; Rule 1999). The informal name shining peppermint includes some members of Series *Radiatae* (*E. dives* Schauer, *E. molyneuxii* K.Rule and *E. willisii* K.Rule) and also *E. nitida* Hook. from the Series *Insulanae* Brooker.

Eucalyptus nitida and *E. simmondsii* Maiden were early names given to Tasmanian populations. Willis (1970) regarded them as synonymous and included all Tasmanian, as well as similar Victorian and South Australian shining peppermint populations, under *E. nitida* which predated *E. simmondsii*.

Studies by Marginson and Ladiges (1982) and Ladiges *et al.* (1983) found that mainland populations had a close affinity with *E. dives* rather than with *E. nitida*. Ladiges *et al.* (1983) erected *E. willisii* as a new taxon primarily on the basis of morphological differences in the seedling stage. Populations of Tasmanian *E. nitida* were found to possess juvenile leaves with few or no oil glands but with protruding glands on the margins, whereas the juvenile leaves of mainland populations were found to be abundantly glandular but without protruding glands on the margins.

Newham *et al.* (1986), in a study including *E. willisii sens. lat.*, erected *E. willisii* subsp. *falciformis* to cater for populations of peppermints occurring in the Grampian Ranges of western Victoria. These populations were found to differ from more typical populations by their reduced amounts of peppermint bark on the trunk, their earlier development of narrow, falcate, vertically-oriented, petiolate juvenile

leaves and their distinctive pattern of volatile oils (higher levels of cineole 1,8 than other populations). The authors regarded all other western populations of Victorian and South Australian shining peppermints as being more closely related to *E. willisii* subsp. *willisii* and retained them within that subspecies. However, Brooker and Slee (1996a), in their treatment of Victorian shining peppermints, apparently regarded these other western populations as differing only slightly from the Grampians' populations and placed them under *E. willisii* subsp. *falciformis*.

Rule (1999) erected *E. molyneuxii* as a new species for the restricted Little Desert populations, whose features included a depauperate habit and appreciably small leaves, buds and fruits, but recognised it as being closely related to *E. willisii* subsp. *falciformis* on the basis of some shared seedling features. Centre for Plant Biodiversity Research (2006) places *E. molyneuxii* under *E. willisii* subsp. *falciformis*, but Nicolle (2006) accepts it at species rank.

In a comprehensive study of the peppermints, including all the shining peppermints, Rankin (1998) analysed adult and juvenile leaf characters as well as chemical character such as flavonoids. On the basis of multivariate analysis of juvenile leaf characters, Rankin (1998) found that a number of *E. willisii* subsp. *falciformis* populations (from Western Victoria) were well separated from *E. willisii sens. strict.* (from Wilsons Promontory) and from a population from the Gippsland Lakes. The differences between these three entities were of the same order (or greater) as differences between established species of peppermints such as *E. pulchella* Desf., *E. amygdalina* Labill. and *E. radiata* Sieber ex DC. However, the population of *E. willisii* from Wilsons Promontory had very similar juvenile leaves to *E. dives*, while *E. willisii* subsp. *falciformis* populations had juvenile leaves that were close to those of *E. nitida*. For adult leaves, the population from Gippsland Lakes differed significantly from *E. willisii sens. strict.* and *E. willisii* subsp. *falciformis*, which both had similar morphology.

On the basis of flavonoid composition, in contrast to juvenile morphology, Rankin (1998) found that *E. willisii sens. strict.* was chemically linked to *E. nitida* (which had a large number of flavonoid compounds), particularly those populations occurring on the Bass Strait Islands, and that two other mainland shining peppermints, namely the populations occurring in the Gippsland Lakes region and *E. willisii* subsp. *falciformis* were more closely related to *E. dives* (which produces relatively few flavonoids, particularly rutin). In fact, Rankin even suggested there is a case for submerging *E. willisii sens. strict.* within *E. nitida* on the basis that it is the end point of a gradation of chemical forms from western Tasmania where typical *E. nitida* occurs, through the Bass Strait Islands, to Wilsons Promontory.

Rankin (1998) synthesises his analyses of morphological and chemical data into a proposed phylogeny in which *E. willisii sens. strict.* was sunk within *E. nitida*, and *E. willisii* subsp. *falciformis* was placed near *E. dives*, and referred to as '*E.* sp. aff. *dives* (Western Victoria)'. The Gippsland Lakes population was also placed near to *E. dives*, as '*E.* sp. aff. *dives* (Eastern Victoria)'.

In regard to *E. willisii*, there are sufficient morphological grounds, particularly those identified by Marginson *et al.* (1982), Ladiges *et al.* (1983) and Rankin (1998), for its retention as a separate species, despite the similarity to *E. nitida* on chemical characters. This position has been further reinforced by Brooker (2000) who placed *E. nitida* with other Tasmanian peppermints in his newly erected Series *Insulanae*, but retained *E. willisii sens. lat.* in the Series *Radiatae*. In segregating the Tasmanian peppermints into a separate series Brooker saw as fundamentally important the differences in juvenile leaf gland patterns identified by Marginson *et al.* (1982) and Ladiges *et al.* (1983).

An examination of herbarium specimens, field studies of a large number of populations and seedling trials, representing all mainland and Tasmanian shining peppermints, has supported Rankin's findings that both the Gippsland Lakes populations and the western mainland populations (*E. willisii* subsp. *falciformis*) are morphologically distinctive from *E. willisii sens. strict.* to the extent that they warrant recognition as separate species.

Material and methods

Seedlings were raised in Debco native plant potting mix. Seedlots were collected from 20 populations, six from the Gippsland Lakes region and 14 from western Victoria and lower south-east South Australia. For each population a minimum of ten seedlings were examined. Leaf thickness was measured with a dial calliper on fresh adult leaves (Table 1).

Table 1: Morphological characters of shining peppermints

Character	*E. nitida*	*E. dives*	*E. willisii*	*E. molyneuxii*	*E. folciformis*	*E. orenicola*
Habit	mallee or tree 5–40 m tall	tree 4–25 m tall	mallee or small tree to 15 m tall	mallee or small tree to 5 m tall	mallee or tree to 15 m tall	mallee or tree 4–12 m tall
Bark	fibrous to various heights on trunk	fibrous to secondary branches	fibrous to secondary branches	loose, sub-fibrous on trunk	smooth or fibrous on trunks to various heights	fibrous to the secondary branches
Juvenile Leaves						
Size	to 6 cm long, 4 cm wide	to 12 cm long, 7 cm wide	to 8 cm long, 3 cm wide	to 13 cm long, 1.5 cm wide	to 17 cm long, 7 cm wide	to 11 cm long, 1.6 cm wide
Shape	elliptical to ovate	cordate to broadly ovate	broadly lanceolate	narrowly lanceolate, falcate	narrowly lanceolate to ovate	narrowly lanceolate
Base	petiolate and discrete (amplexicaul on Bass Strait Islands)	amplexicaul for numerous pairs	amplexicaul for numerous pairs	discrete and petiolate	discrete and petiolate	amplexicaul for at least 10 pairs, sessile for numerous pairs
Orientation	vertical in early seedling development (horizontal for numerous pairs on Bass Strait Islands)	horizontal for numerous pairs	horizontal for numerous pairs	vertical in early seedling development	vertical in early seedling development	horizontal for numerous pairs
Colour/lustre	blue-green, dull	blue-grey to glaucous, dull	blue-grey, dull	sub-lustrous, green	blue-green, dull	blue-grey, dull
Protruding Marginal Glands	present	absent	absent	absent	absent	absent
Oil Gland Density	glands few or absent (high on Bass Strait Islands)	high	high	high	high	high
Adult Leaves						
Size	to 15 cm long, 2.0 cm wide	to 15 cm long, 4.0 cm wide	to 14 cm long, 2.0 cm wide	to 11 cm long, 1.6 cm wide	to 22 cm long., 3.5 cm wide	to 14 cm long, 1.7 cm wide
Thickness	not available	0.30–0.44 mm	0.20–0.30 mm	0.38–0.52 mm	0.30–0.42 mm	0.30–0.40 mm
Shape	lanceolate	broadly lanceolate or ovate-lanceolate	lanceolate	narrowly lanceolate, slightly falcate	lanceolate, falcate	narrowly lanceolate
Colour/lustre	green, lustrous	blue-green or green, dull or sub-lustrous	blue-green, dull or sub-lustrous	green, lustrous	blue-green, sub-lustrous	green, lustrous
Buds per inflorescence	11–21	11–21	15–21	11–15	11–17	11–17
Bud Size	4–5 mm long, 2–3 mm diam.	6–8 mm long, 3–4 mm diam.	5–7 mm long, 2–3 diam.	5–7 mm long, 3–4 mm diam.	6–9 mm long, 3–5 mm diam.	5–6 mm long, 3–4 mm diam.
Fruits						
Size	5–8 mm long, 5–9 mm diam.	5–7 mm long, 4–7 mm diam.	4–5 mm long, 4–6 mm diam.	4–5 mm long, 5–6 mm diam.	6–8 mm long, 6–8 mm diam.	5–7 mm long, 7–9 mm diam.
Shape	hemispherical to obconical	hemispherical, obconical or cupular	hemispherical to obconical	cupular or slightly obconical	obconical, cupular or sub-cylindrical	hemispherical to slightly cupular
Pedicel Length	1–3 mm	1–3 mm	1–3 mm	0–2 mm	3–6 mm	3–5 mm

Key to shining peppermints

1	Protruding glands present along the margins of juvenile leaves; juvenile leaves with few or no oil glands ..... ***E. nitida***
1:	Protruding glands absent from margins of juvenile leaves; juvenile leaves with numerous oil glands 2
2	Juvenile leaves amplexicaul and horizontally-oriented for numerous pairs 3
2:	Juvenile leaves becoming basally discrete, petiolate and vertically-oriented in early seedling development 5
3	Juvenile leaves cordate to broadly ovate, 4-7 cm wide; adult leaves broadly lanceolate to ovate, 2-4 cm wide ..... ***E. dives***
3:	Juvenile leaves lanceolate (narrow to broad), 0.8-3 cm wide; adult leaves narrowly lanceolate to lanceolate, < 2 cm wide 4
4	Adult leaves dull or slightly lustrous, blue-green; fruits 4-6 mm diam. ..... ***E. willisii***
4:	Adult leaves lustrous, green; fruits 7-9 mm diam. ..... ***E. arenicola***
5	Adult leaves green, to 1.6 cm wide; fruits 5-6 mm diam. ..... ***E. molyneuxii***
5:	Adult leaves blue-green, to 3.5 cm wide; fruits 6-8 mm diam. ..... ***E. falciformis***

Taxonomy

1. *Eucalyptus arenicola* K.Rule *sp. nov.*

E. willisii *affinis foliis juvenilibus angustioribus, foliis adultis nitentioribus viridioribus, fructibus majoribus differt, et affinis* E. diviti *sed foliis juvenilibus angustioribus, foliis adultis angustioribus nitentioribus viridioribus, fructibus majoribus differt.*

***Type*: VICTORIA**. 5.1 km WSW of Loch Sport, 38°04'S 147°33'E, *K. Rule 0421*, 6.ii.2004 (holotype: MEL; isotype: AD, CANB, HO, NSW).

Small *mallees* or *trees*, 4–12 m tall. *Branchlets* pendulous. *Bark* greyish, finely fibrous, thick, longitudinally fissured, peppermint-type, extending to the secondary branches. *Seedling leaves* narrowly ovate or ovate-lanceolate, sessile, basally rounded, decussate, discolorous; upper surface, dull, blue-green; lower surface whitish; raised glands present on seedling stems only in early development. *Juvenile leaves* sub-linear to narrowly lanceolate and amplexicaul for at least 10 pairs, remaining horizontally-oriented, sessile and opposite for 15–20 pairs, acuminate or apiculate, discolorous, dull, blue-grey, non-pruinose, 5–11 cm long, 0.8–1.6 cm wide. *Intermediate leaves* lanceolate or broadly lanceolate, sometimes slightly falcate, petiolate, opposite, sub-opposite and alternate, sub-lustrous, blue-green or green. *Adult leaves* narrowly lanceolate or lanceolate, often slightly falcate, acuminate, uncinate, moderately reticulate, glandular, concolorous, lustrous, green, moderately coriaceous (0.3–0.4 mm thick), 7–14 cm long, 0.9–1.7 cm wide; petioles to 1.6 cm long; lateral veins acute, diverging at < 25° from the mid-vein; intramarginal vein 1–2 mm from the margin; oil glands regular, relatively large, relatively dense, island. *Inflorescences* simple, axillary, 11–17-flowered; peduncles angled, 7–12 mm long. *Floral buds* clavate, shortly pedicellate, unscarred (outer operculum only), 5–6 mm long, 3–4 mm wide at anthesis; pedicels 4–6 mm long; operculum obtuse-conical, becoming hemispherical at anthesis; locules 3 or 4; ovules in 2 vertical rows; filaments white; stamens inflexed, all fertile; anthers versatile, sub-basifixed, reniform, dehiscing through oblique, confluent slits; flowering period winter. *Fruits* sub-sessile to pedicellate, hemispherical or slightly cup-shaped, 5–7 mm long, 7–9 mm wide; pedicels 3–5 mm long; disc at rim level, c. 2 mm wide; orifice small, 3–4 mm wide; valves 3 or 4. *Fertile* seeds black-brown, irregularly pyramidal; dorsal surface rounded; hilum ventral. (Fig. 1.)

***Additional specimens examined:* VICTORIA**. GIPPSLAND LAKES REGION. Holey Plains S.P., c. 0.7 km along Wildflower Road from the intersection with the main NW-SE running track, 38°13'S 146°52'E, *D.E. Albrecht 5023*, 20.x.1992 (MEL 2133886); Gippsland Lakes Coastal Park, *A.C. Beauglehole ACB74850* and *W.R. Beauglehole*, 27.x.1983 (MEL 1613401); 3.6 km along Redcourt Lane S from the Princes Hwy., 8 km W of Bairnsdale, 37°54'S 147°29'E, *D.E. Albrecht 2446*, 18.ii.1986 (MEL 112667); c. 1 km E of Loch Sport turnoff on the Longford-Paradise Beach Road, 38°11'05"S 147°21'09"E, *M.I.H. Brooker 12209* and *A.V. Slee*, 23.iv.1995 (MEL 270931); Sperm Whale

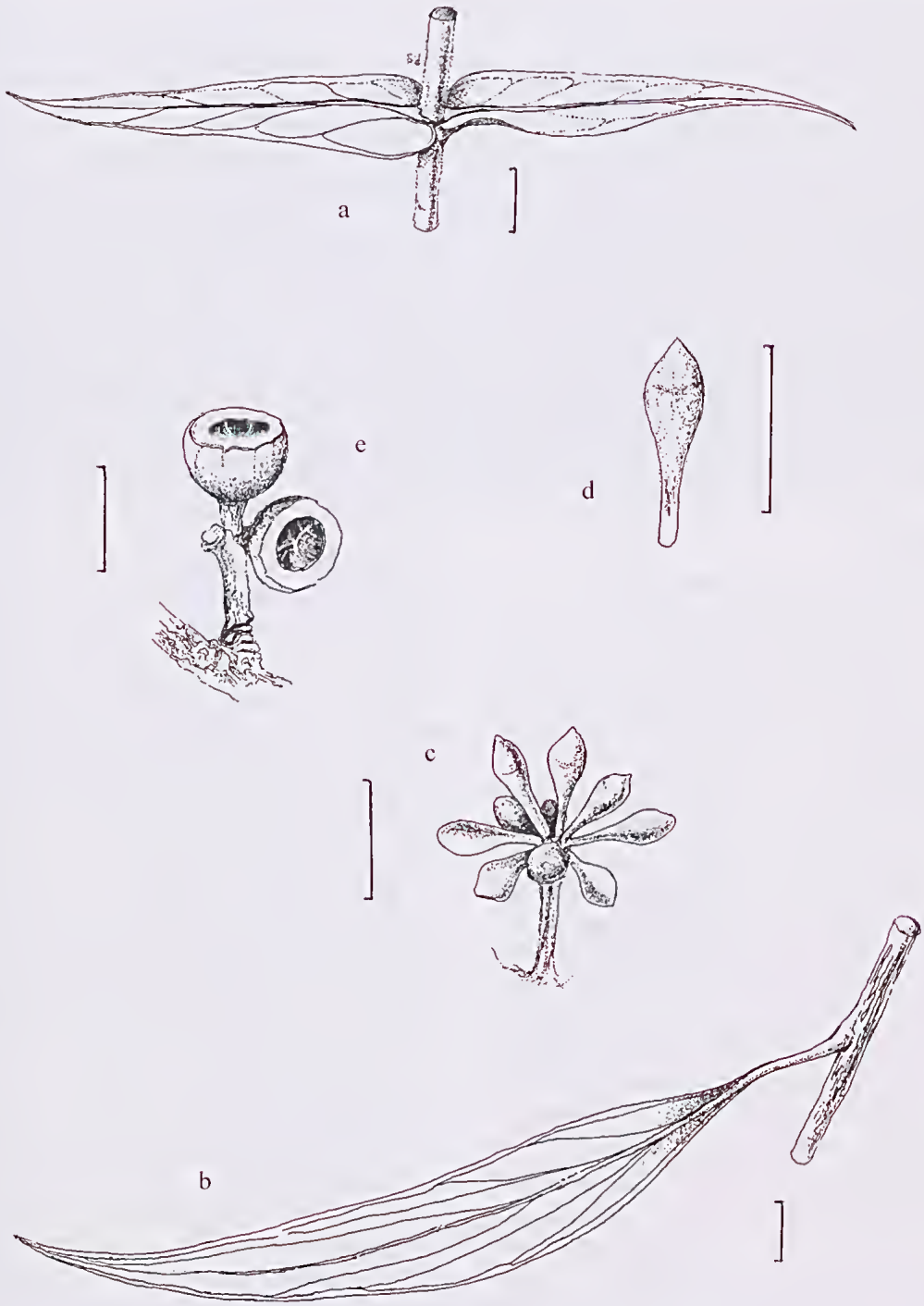

Figure. 1. *Eucalyptus arenicola* (all from K. Rule 0421): **a.** juvenile leaves at 8th pair; **b.** adult leaf; **c.** inflorescence; **d.** bud; **e.** fruits. Scale bars = 1 cm.

Head Pen., Gippsland Lakes N.P. 37°58'S 146°51'E, *J.H. Willis*, 28.iv.198S (MEL 686123); Providence Ponds, 37°55'S 147°17'E, *A.C. Beauglehole* and *K. Rogers*, 15.xi.1971 (MEL 519779); Holey Plains S. P., Chessum Road, 1.2 km NE of boundary within pine plantation near Willung, 38°14'02"S 146°50'07"E, *A.V. Slee* and *P. Downey 4016*, 11.xii.1996 (MEL 2S8S87); Dutson to Loch Sport Road, 38°11'S 147°13'E, *B. Nicholson*, 28.v.1968 (MEL 27273); Lime Quarry Road, c. 5 km SSE of Rosedale, 38°12'30"S 146°S1'00"E, *J.H. Willis*, 2.ii.1972 (MEL S02306); Longford Road, 3 mls. N of Gifford, 38°22'S 147°07'E, *J.H. Willis*, 24.i.1980 (MEL 574960); 3 mls. W of Loch Sport, 38°06'S 147°30'E, *A.C. Robinson*, 24.ii.197S (MEL 161356).

Distribution and habitat: *E. arenicola* grows in sandy soils close to the Gippsland Lakes in both coastal and sub-coastal districts, from near Bairnsdale in the east to Holey Plains in the west (Fig. 2). The annual rainfall of Sale, which is within the distribution of the species, is slightly more than 600 mm and has a slight spring maximum.

Associated species: *E. arenicola* mostly grows in pure stands but occurs with or close to *E. pryoriana* L.A.S.Johnson, *E. croajingolensis* L.A.S.Johnson & K.D.Hill, *E. angophoroides* R.T.Baker, *E. cephalocarpa* Blakely or *E. polyanthemos* subsp. *vestita* L.A.S.Johnson & K.D.Hill. It also is associated with a form of *E. consideniana* Maiden which mimics its morphology.

Etymology: The epithet is derived from the Latin *arena* 'sandy' and *cola* 'dweller' in reference to the habitat of the species.

Conservation status: Where it occurs, *E. arenicola* is a dominant species. It is particularly abundant in the Gippsland Lakes Coastal Park in the vicinity of Loch Sport from where the type specimen has been collected. It is not considered at risk.

Discussion: *E. arenicola* is a shining peppermint distinguished within the Series *Radiatae* by the following combination of features; small habit; fibrous peppermint bark which extends to the secondary branches; numerous pairs of sub-linear to narrowly lanceolate, opposite, amplexicaul, horizontally-oriented juvenile leaves; lustrous and green, coriaceous adult leaves; 11–17-flowered inflorescences; and relatively large, thick-walled, hemispherical to slightly cupular fruits.

Eucalyptus arenicola shares features with *E. willisii* (which appears to be confined to Wilsons Promontory). Both species have a full peppermint bark, the same seedling ontogeny and fruits with a broad, flattened disc. However, *E. willisii* is distinguished by its broadly lanceolate juvenile leaves, thinner, duller adult leaves, usually more numerous buds per inflorescence and smaller buds and fruits. Further, *E. willisii* differs chemically from *E. arenicola* by its more complex pattern of flavonoid compounds (Rankin 1998).

Eucalyptus arenicola has an affinity with *E. dives*, which differs in its broader juvenile leaves, broader, often duller and bluish adult leaves and generally smaller fruits.

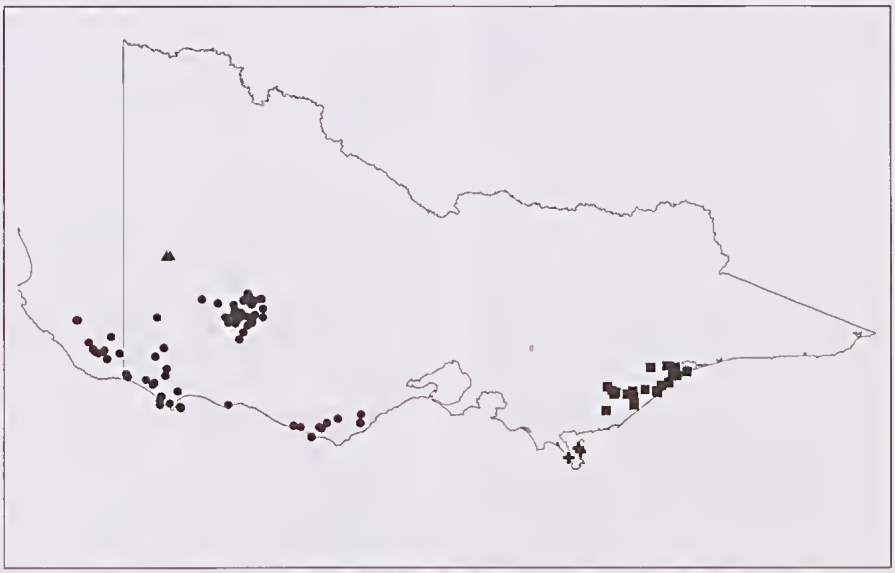

Figure. 2. Distributions of *E. willisii* (cross), *E. orenicolo* (square), *E. falciformis* (circle) and *E. molyneuxii* (triangle).

Eucalyptus falciformis (treated below) is another relative of *E. arenicola* but differs by its generally taller habit; variable peppermint bark, which is confined to the base of the trunk or extends to the upper trunk; broader, non-amplexicaul, vertically-oriented, petiolate, often disjunct juvenile leaves; larger, bluish adult leaves and slightly more elongated fruits.

Eucalyptus arenicola can grow with *E. consideniana*, which may appear superficially similar at the adult stage, but differs in the petiolate, disjunct juvenile leaves and the yellow under bark.

2. *Eucalyptus falciformis* (Newnham, Ladiges & Whiffin) K. Rule *stat. nov.*

Eucalyptus willisii subsp. *falciformis* Newnham, Ladiges & Whiffin, *Australian Journal of Botany* **34**, 348 (1986)

***Type*: VICTORIA**. Intersection of Taylor Rd. and Burrong Shortcut, W of Mt. Victory, Grampian Ranges, 37°10'40"S 142°14'40"E, 12.vi.1985, *M. Newnham 64* (holotype: MEL 673439; isotype: FRI, NSW).

Slender *trees* or less often robust, spreading mallees, 5–15 m tall. *Branches* usually pendulous. *Bark* grey-brown, peppermint type, variable in height, as a short, basal stocking or extending to the upper trunk; basal bark often thick, crusty and deeply fractured; upper bark smooth, off-white or pale brown, decorticating in broad sheets and ribbons. *Seedling leaves* decussate, ovate or ovate-lanceolate, basally rounded, sessile, discolorous; upper surface green; lower surface whitish; raised glands present on seedling stems in early seedling development but later becoming inconspicuous. *Juvenile leaves* narrowly lanceolate, lanceolate, ovate-lanceolate or ovate, falcate, amplexicaul only for a few pairs but becoming basally discrete by the 6th node, twisting and becoming vertically-oriented and shortly petiolate usually by the 10th node, often becoming disjunct by the 13th node, slightly discolorous, dull, blue-grey, 8–17 cm long, 1.5–7 cm wide. *Intermediate leaves* broadly ovate to broadly lanceolate, usually falcate, disjunct, petiolate, becoming concolorous, dull, blue-green, larger than the juvenile and adult leaves. *Adult leaves* lanceolate, falcate, acuminate, uncinate, moderately reticulate, glandular, dull or sub-lustrous, blue-green, moderately coriaceous (0.30–0.42 mm thick), 10–22 cm long, 1.7–3.5 cm wide; petioles to 2.2 cm long; lateral veins, markedly acute, diverging at < 20° from the mid-vein; intramarginal vein 2–3 mm from margin; oil glands regular, smallish, moderately dense, mostly island. *Inflorescences* simple, axillary, occasionally paired, 11–17-flowered; peduncles 8–12 mm long. *Floral buds* clavate, pedicellate, 6–9 mm long, 3–5 mm wide, unscarred conical or obtuse-conical, as wide as hypanthium; locules 3 or 4; ovules in 2 vertical rows; filaments white; stamens inflexed, all fertile; anthers dorsifixed, versatile, reniform, dehiscing through oblique, confluent slits; flowering period spring. *Fruits* pedicellate, slightly obconical, cup-shaped, or sub-cylindrical, 6–8 mm long, 6–8 mm diam.; pedicels 3–6 mm long; disc broad, c. 2 mm wide, slightly rolled, level with rim or slightly descending; valves 3 or 4 enclosed or flat. *Fertile seeds* black-brown, irregularly pyramidal; dorsal surface rounded; hilum ventral.

***Additional specimens examined*: VICTORIA**: Moomowong Road, 2 km S of Carlisle River, 2.5 km from junction with Gellibrand River Road, 38°35'S 143°24'E, *K. Godfrey 19*, 21.v.2001 (MEL 2117489); near Wartook Res., Grampians, 37°04'S 142°28'E, *L.A.S. Johnson*, 28.i.1965 (MEL711215); Victoria Range, Grampians, east side of Victoria Valley Road, NE of Strachans, 37°22'S 142°18'E, *A.C. Beauglehole ACB1352*, 16.xi.1966 (MEL 531795); Victoria Gap, N of Gap Track, 37°10'S 142°17'E, *A.C. Beauglehole ACB17343* and *M. Corrick*, 1.x.1967 (MEL 531794); corner of Serra and Syphon tracks, 37°16'S 142°22'E, *P. Matthews*, 22.x.1976 (MEL 524561); Grampians N. P., Serra Range, 0.5 km W of top of Mirranatwa Gap, 37°25'S 142°27'E, *A.V. Slee 3107*, 29.viii.1990 (MEL 1588506); Goat Track, at the intersection with Victoria Range Road, 37°14'15"S 142°18'00"E, *D.E. Albrecht 2534*, 7.iii.1986 (MEL 112715); 6 km N from Wartook Road along Mt. Difficult Road, Mt. Difficult Range, 37°03'S 147°27'E, *V. Stajsic 227*, 2.iii.1991 (MEL 1597566); Parish of Carracut near Digby, 37°48'S 141°32'E, *R. Riley*, 8.ix.1947 (MEL 703723); Lower Glenelg River, 38°04'S 141°14'E, *J.H. Willis*, 29.x.1948 (MEL 703722); Little Moleside Creek, Lower Glenelg River, 38°07'S 141°19'E, *J.H. Willis*, 14.vi.1964 (MEL 703682); Portland Dist., SW Victoria, northern road into Bridgewater Lakes, 38°19'S 141°24'E, *F. Swindley 1621*, 4.iv.1963 (MEL 1254); Henty Hwy. C 100 m N of bridge over Surry R., 38°12'S 141°37'E, *N.G. Walsh 5224*, 23.viii.2000 (MEL 2089840); 1 km W of Chapple Vale on Lavers Hill Road E of Gellibrand River Road, 15 km W of Lavers Hill, 38°38'00"S 143°18'25"E, *B.J. Conn 2941* and *J.A. Scott*, 22.v.1988 (MEL 1589119); Port Campbell N. P., 300 m above Ocean Road – London Bridge Road Junction, 38°37'S 143°00'E, *N.G. Walsh 1249*, 29.v.1984 (MEL 662257). *SOUTH AUSTRALIA*: Honan's Scrub, 37°37'S 140°33'E, *R.J. Bates 32248*,

17.iv.1993 (MEL 205583S); c 1.5 km NE of Nangwarry township, 37°33'S 140°49'E, *I.B. Wilson 988*, 2.iii.1969 (MEL 1614438); 3 km SSE of Glencoe in Honan's Scrub, 37°43'54"S 140°38'00"E, *P.J. Lang 2464*, 21.xi.1994 (MEL 249732); triangle W of Wandillo, 37°44'S 140°43'E, *M.I.H. Brooker 3815*, 29.xii.1972 (MEL 649519); 22.3 km E of Princes Hwy., between Robe and Penola, 37°21'S 140°24'E, *M.I.H. Brooker 11549*, 7.viii.1993 (MEL 722635); 3.8 km NE of Wandillo railway siding, *I.B. Wilson 989*, 17.iii.1969 (MEL 703689).

Distribution and habitat: *E. falciformis* usually occurs on impoverished, well-drained sandy soils in a variety of habitats across the moist, temperate regions of south-west Victoria, as well as the Grampian Ranges, and adjacent areas of South Australia, from the Otway Ranges in the east to Millicent in the west. Whilst populations in the Grampians occur as high as 1000 m altitude, others occur in undulating terrain or on cliff tops close to the ocean (Fig. 2).

Associated species: In the Grampians a common associate of the new species is *E. baxteri* (Benth.) Maiden & Blakely. Other associates include *E. alaticaulis* R.J.Watson, Ladiges & A.R.Griffin, *E. melliodora* A.Cunn. ex Schauer, *E. obliqua* L'Her., *E. aromaphloia* Pryor & J.H.Willis and *E. sabulosa* K.Rule. In coastal and sub-coastal regions *E. ovata* Labill. var. *ovata* and var. *grandiflora* Maiden, *E. baxteri*, *E. pauciflora* Sieb. ex Spreng. subsp. *pauciflora*, *E. viminalis* Labill. subsp. *viminalis* and subsp. *cygnetensis* Boomsma and *E. splendens* subsp. K.Rule *splendens* may occur in association with *E. falciformis*.

Conservation status: *E. falciformis* is abundantly present throughout its range and is not considered at risk.

Discussion

Eucalyptus falciformis is distinguished within the Series *Radiatae* by its smallish, usually tree-like habit; variable bark which does not extend to the major branches; falcate, basally discrete, petiolate, vertically-oriented, disjunct juvenile leaves; relatively large, coriaceous dull to sub-lustrous, bluish adult leaves; 11–17-flowered inflorescences; relatively long buds and relatively large, slightly elongated, thick-walled fruits.

Eucalyptus molyneuxii is considered to be the nearest relative of *E. falciformis* as both exhibit the early development of vertically-oriented, petiolate, basally-tapered, eventually falcate juvenile leaves. *Eucalyptus molyneuxii*, however, differs by its smaller habit; greener, narrower juvenile leaves; smaller, thicker, more lustrous, greener adult leaves; smaller buds and smaller fruits which are borne on shorter pedicels.

Eucalyptus dives is also considered to be related to *E. falciformis* as the two are markedly similar in most adult features, particularly in their buds and fruits. However, *E. dives* is different primarily by its more persistent peppermint-type bark, which covers the major branches; cordate to broadly ovate, amplexicaul, horizontally-oriented, opposite, sessile, usually glaucous juvenile leaves and generally smaller fruits.

Eucalyptus willisii is distinguished from *E. falciformis* by its persistent pairs of opposite, sessile, horizontally-oriented juvenile, and by its thinner, more glandular adult leaves and smaller buds and fruits. With regard to oil gland density in adult leaves, Newnham *et al.* (1986) found that populations of western peppermints, including those of the Grampians (*E. falciformis*), contained approximately half the number oil glands than those found in *E. willisii sens. strict*. Further, as discussed above, *E. willisii* differs chemically from *E. falciformis* by its more complex pattern of flavonoid compounds.

Eucalyptus falciformis is a taxon which exhibits regional variation, not only in the amount of peppermint bark held on the trunk, in juvenile leaf shape and size and in patterns of volatile oils, but also in leaf lustre, fruit size and shape, and which may require further research with a view to describing new infraspecific taxa. Populations in the foothills to the north, north-west and west of the Otway Ranges are substantially rough-barked with relatively small fruits (c. 6 mm long, 6 mm diam.). Brooker and Slee (1996b) made reference to an intermediate form between *E. willisii* subsp. *falciformis* and *E. radiata* occurring in the northern Otway Ranges, but whether they were referring to this form is unclear. Depauperate trees occurring in the vicinity of Moonlight Head have duller adult leaves than typical. Populations occurring in the far south-west of Victoria and adjacent areas of South Australia are substantially rough-barked and have larger, less-elongated fruits than the typical form of the Grampians (fruits 7-8 mm long, 7-8 mm diam.). A small population occurring in Victoria near Curdie Vale to the west of Timboon has fruits of a similar size to more westerly populations.

Notes on the distribution of *Eucalyptus willisii:* There are a number of collections housed in MEL of peppermints occurring in the regions of Central Victoria and south-west Gippsland which have been determined as *E. willisii* subsp. *willisii*, and the south-west Gippsland collections have been mapped as such by Brooker & Slee (1996b) and Nicolle (2006). After the careful examination of these specimens (Appendix 1, Part A), as well as visiting as many collection sites as possible and conducting seedling trials where necessary, most specimens should be determined as *E. radiata* subsp. *radiata* and none are *E. willisii*. In a few cases, where inadequate site information has been provided, searches of the general localities were conducted, and only *E. radiata* subsp. *radiata* was located.

There are also some collections in MEL which have been determined as intergrades between *E. willisii* subsp. *willisii* and *E. radiata* subsp. *radiata*. These are all regarded here as aberrant forms of the second taxon (Appendix 1, Part B).

Brooker and Slee (1996b) reported an occurrence of a pruinose form of *E. willisii* subsp. *willisii* to the south of Sale in the Longford area (*M.I.H.Brooker 11126*, 6.vi.1992, MEL 1616799). Field observations and seedling trials show that these plants are hybrids between *E. croajingolensis* and *E. arenicola*, both of which occur in the area.

Further, *E. willisii* has been reported anecdotally as occurring in south-west Gippsland in localities including Healesville, Bunyip State Park, Flinders, Walkerville, Liptrap, Yanakie, Leongatha, Grantville and Hedley. I have conducted searches of each of these localities and found only *E. radiata* subsp. *radiata*.

The best diagnostic features of *E. radiata* subsp. *radiata* include lanceolate, dull to slightly lustrous, light green juvenile leaves, relatively thin, usually dull, blue-green adult leaves and smallish, hemispherical to sub-globular, relatively thin-walled fruits. However, the taxon also exhibits a high degree of variability in leaf colour, lustre and width and in fruit size and disc orientation. In many cases it is reasonable to speculate that misidentifications have occurred where individuals or even small populations of *E. radiata* subsp. *radiata* have superficially resembled *E. willisii* by exhibiting lustrous and green adult leaves during the growing season or fruits with level and slightly broader discs than typical. In a few cases, such as near Hedley and in the Liptrap area, the trees alleged to be *E. willisii* are *E. radiata* subsp. *radiata* in most respects but exhibit slightly different foliage to more typical forms of *E. radiata* subsp. *radiata* occurring in the region.

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Special thanks are given to Dr David Rankin of Hobart for his collaboration on this project. At the National Herbarium of Victoria (MEL), Neville Walsh is thanked for providing the Latin diagnoses for *E. arenicola* and for his advice regarding many aspects of this project, as are Dr Tom May for his valuable assistance with the preparation of the manuscript, Catherine Gallagher for facilitating the examination of herbarium specimens and Alison Vaughan for constructing the distribution map of the treated taxa. Similarly, thanks are given to David Robbins, Chris Jenek and Jeremy Prentice of the Royal Botanic Gardens Melbourne for their contributions to the project's seedling trials. Thanks are also given to David Cameron (Arthur Rylah Institute), Bill Molyneux (Dixon's Creek) and Val Stajsic (MEL) for their many contributions to this project and to studies of the wider peppermint group. Lastly, special thanks is given to Peter Strickland of Balnarring for his meticulous work in preparing the illustration.

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Appendix 1

Some aberrant and otherwise previously mis-identified collections of *Eucalyptus radiata* subsp. *radiata*

PART A: collections previously determined as *E. willisii* subsp. *willisii*.

Mornington Peninsula, Dromana, along Boundary Road, between Shergolds Lane and Eatons Cutting Road, 38°22'S 144°S8'E, *K. J. Marks 3*, 19.vii.1987 (MEL 1557728); 600 m W of Gumbya Park, 38°08'5 14S°38'E, *M.I.H. Brooker 10941*, 7.ii.1992 (MEL 1616823); 4.4 km E of Foster centre on Welshpool Road, 38°39'S 145°15'E, *M.I.H. Brooker 1178*, 9.iii.1994 (MEL 1619208); c. 10 km along South Gippsland Hwy. (from the junction with the Bass Hwy.) towards Korumburra, 38°20'S 14S°37'E, *M.I.H. Brooker 7789* (MEL 6286S3); Red Shirt Gully Road, St. Andrews, 37°36'S 145°16'E, *R.A. Kilgour 286*, 14.x.1982 (MEL 629395); Warrandyte State Park, Jumping Creek Road, 37°44'S 145°15'E, *D.J. Van Boekel*, 1990 (MEL 226956); near 90 km post on South Gippsland Hwy., behind Lang Lang Golf Club, 38°18'S 145°33'E, *D. McMahon* (MEL 226988); Dandenong, 37°59'S 145°13'E, (Collector unknown), 1861 (MEL 1607234); south of Gisborne at blue metal pile, 37°31'S 144°37'E, *M.I.H. Brooker 11980*, 30.viii.1994 (MEL 2S7822); heathland, Walkerville, Waratah Bay, 38°52'S 145°59'E, *C. Carbury*, late Feb. 1951 (MEL 152671); roadside, Clark's Road, Enfield, 37°45'S 143°47'E, *G. Jamieson 32*, 11.ix.1982 (MEL 1609566); Cape Patterson, 38°39'S 145°34'E, *A.E. Kitson* (MEL 1615639); Arthurs Seat, 38°21'S 147°57'E, *F. Mueller* (MEL 1614094); Eltham, 37°43'S 145°07'E, *P.R.H. St. John*, 22.viii.1910 (MEL 703676); near Balnarring, Mornington Peninsula, 38°23'S 145°07'E, *J.H. Willis*, 21.i.1963 (MEL 706162); Berwick, 38°02'S 145°21'E, *G.W. Robinson* (MEL 1614112); Traralgon, 38°12'S 146°32'E, *A.W. Howitt* (MEL 1614121); 3.5 km N of Mirboo North, 22 km NE of Leongatha 38°23'5 146°10'E, *A.C. Beauglehole ACB 62045*, 13.xii.1978 (MEL 1S13959); near Brighton, 37°S5'S 144°59'E, *F.M. Reader*, 9.xii.1884 (MEL 1614116); Yarra River, 37°45'S 145°02'E, *F. Mueller* (MEL 232016); near the Dandenong Ranges, 37°52'S 145°18'E, *F. Mueller* (MEL 1615643); M.M.B.W. Sewerage Farm, Braeside, W of Springvale Road, 37°59'50"S 145°08'00"E, *H.I. Ashton 2047*, 21.vi.1981 (MEL 1520278); French Island, S.5 mls. NE of Tankerton P.O., 38°19'S 145°22'E, *A.C Beauglehole ACB38227*, 5.v.1972 (MEL 1021447).

PART B: collections previously determined as *E. willisii* subsp. *willisii*-*E. radiata* subsp. *radiata* intergrades.

Gisborne-Bacchus Marsh Road, opposite Sunbury Water Filtration entrance, 3.2 km E of Waterloo Flat Road Turnoff, 37°29'S 144°34'E, *M.I.H. Brooker 11961*, 17.vii.1994 (MEL 2036918); 2.3 km 5 of Woodend towards Gisborne on Calder Hwy., 37°23'S 144°32'E, *G. Chippendale* and *M.J. Brennan*, 15.vii.1975 (MEL 706173); Wallan, 30 mls. N of Melbourne, c. 0.5 mls. N of Wallan Railway Station, 37°25'S 145°00'E, *H.L. Gray*, 11.i.1971 (MEL 1010207); Cranbourne Annex of the Melb. Bot. Gardens, 38°08'S 145°16'E, *K. Hill 1592, L.A.S. Johnson* and *K. Wilson*, 4.iii.1986 (MEL 698598); Eltham, 37°43'S 145°09'E, (collector unknown), viii.1910 (MEL 577553).

Notes on some Australian *Triglochin* (Juncaginaceae) annuals: typification and nomenclature

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Abstract

Type material of *Triglochin calcitrapa* Haak. var. *pedunculata* Buchenau and *T. calcitrapa* Haak. var. *sessiliflora* Buchenau is discussed and lectotypes are chosen for both varietal names. The var. *pedunculata* is placed in synonymy under *T. isingiana* (J.M.Black) Aston, *stat. nov.*, and the var. *sessiliflaro* is considered a synonym of the autonym *T. calcitrapa* Haak. var. *calcitrapa*. A further collection cited under *T. calcitrapa* Hoak. by Buchenau is placed within an informally named taxon *Triglochin* sp. *A* (Aston ms.). The varieties *T. calcitrapa* var. *isingiano* J.M.Black and *T. centrocarpa* Haok.. var. *langicarpa* Ostenf. are raised to specific rank as *stat. nav.* Reference is made to the exclusion of *T. racemaso* Endl. from *Triglochin* L. and from Juncaginaceae.

The gender treatment of *Triglochin* in published works has varied, but throughout this paper it is treated as feminine in accordance with a definitive ruling of the ICBN (McNeill *et al.*, 2006, Art. 6.2 Ex. 5).

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Introduction

Several nomenclatural changes for annual taxa of *Triglochin* native to Australia involve explanations of type material, selection of lectotypes and change of status. Information concerning these is published here as a pre-cursor to the account of Juncaginaceae (Aston ms.) accepted for the forthcoming volume 39 of the *Flora of Australia* series.

Nomenclature and Typification

Triglochin calcitrapa Hook., *Icon. Pl.* 8:t.731 (1845), var. *calcitrapa*

[autonym established by publication of *T. calcitrapa* var. *pedunculata* Buchenau, *q.v.* below]. *Triglochin centrocarpa* var. *calcitrapa* (Hook.) Benth., *Fl. Austral.* 7: 167 (1878).

Holotype: Swan River, W.A., 1845, *J.Drummond 17*; K *n.v.* (photo MEL); isotype: MEL.

Triglochin calcitrapa var. *sessiliflora* Buchenau in H.G.A.Engler, *Pflanzenr.* Heft 16, IV.14: 12 (1903), *nom. illeg., nom. inval., pro parte*, as to Drummond 17 only.

Lectotype (here chosen): Swan River, W.A., 1845, *J.Drummond 17*; K *n.v.* (photo MEL); isolectotype: MEL.

Buchenau divided *Triglochin calcitrapa* into two varieties which he named var. *sessiliflora* and var. *pedunculata*. He cited three collections, including the type of the species name (*Drummond 17*), without clearly designating which collection referred to each variety. However, from his descriptions and an accompanying note it is evident that he included *Drummond 17* within his var. *sessiliflora*. The name *T. calcitrapa* var. *sessiliflora* Buchenau must therefore be a synonym of the autonym *T. calcitrapa* var. *calcitrapa* (McNeill *et al.*, 2006, Art. 26.1), and is both illegitimate and invalid because it is based on the same type as that of the autonym (McNeill *et al.*, 2006, Art.52.1 & 26.2).

In addition to *Drummond 17* Buchenau also cited "Stirlingsberge" [Stirling Range],W.A., without collector or date, and Mt Lyndhurst, S.A., *M.Koch 268* under *T. calcitrapa*. The latter collection has sessile fruits

and would have been included by Buchenau under *T. calcitrapa* var. *sessiliflora* but it correctly belongs with a taxon which is to be circumscribed as *Triglochin* sp. A in the forthcoming volume 39 of the *Flora of Australia*.

The collection from "Stirlingsberge" is the only one of the three cited by Buchenau which could possibly have been placed by him under his var. *pedunculata* and it should be considered the type collection of that variety. I have not seen Buchenau's authentic material (B, destroyed in fire of 1943?) but a collection by F. Mueller previously housed at MEL under *T. calcitrapa* [*sens. lat.*] may be duplicate material. The collection is labelled in Mueller's hand "... north of Stirlings Range ..., Oct. 1867" and has pedicellate fruits. It agrees with another collection at MEL, Yallingup Cave, W.A., 26–27 Sept. 1914, *C.H.Ostenfeld 141–142*, which has Ostenfeld's determinavit as *T. calcitrapa* var. *pedunculata* Buchenau. Ostenfeld's determination of his own collection as Buchenau's taxon could be expected to be correct as in *Dansk Bot. Ark.* 2 (8): 31 (1918) Ostenfeld states that he had access to the material in Berlin used by Buchenau. Both the Mueller and the Ostenfeld collections are placed by the current author under *Triglochin isingiana* (see below).

Triglochin sp. A (Aston ms.) and *T. isingiana* (see both below) have been included within *T. calcitrapa* in most state floras. However, *T. calcitrapa* Hook. *sens. str.* is confined to south-western Western Australia.

Triglochin calcitrapa var. *pedunculata* Buchenau in H.G.A.Engler, *Pflanzenr.* Heft 16, IV.14: 12 (1903).

Lectotype (here chosen): "Stirlingsberge" [Stirling Range], W.A., s. *dat., coll. not stated* [F. Mueller ?]; B *n.v.* [not extant?]; possible isolectotype: North of Stirlings Range, Oct. 1867, *F.Mueller*, MEL.

From three collections cited by Buchenau under *T. calcitrapa*, the "Stirlingsberge" collection is the only one which can be considered as the type collection of *T. calcitrapa* var. *pedunculata*. The variety is here placed as a synonym of *T. isingiana*, *q.v.* below. See full explanation above under *T. calcitrapa* var. *calcitrapa*.

In the *Australian Plant Name Index* (APNI), Chapman (1991) included *T. calcitrapa* var. *pedunculata* Ostenf. and stated that C.E.H.Ostenfeld's name was both invalid and a *nomen nudum*, being based only on a figure without diagnosis or description. Chapman's reference for listing this name is *Dansk Botanisk Arkiv* 2(8), t. IV fig.7 (1918), a figure which is included in a revision by Ostenfeld of Western Australian *Triglochin* (*op.cit.*, p.30-39). However, it is clear from this publication that Ostenfeld did not designate the name attributed to him in APNI but was instead referring to the name already designated by Buchenau. Under *T. calcitrapa* Hook., Ostenfeld referred on page 33 to both varieties "*a, sessiliflora* Buchenau" and "*β, pedunculata* Buchenau". His caption to the figure cited in APNI is "*T. calcitrapa*, var. *pedunculata*, from W.A., Yallingup Cave.", and indicates simply that the figure is drawn from Ostenfeld's own collection from Yallingup Cave which Ostenfeld had identified as Buchenau's variety. This interpretation is further supported by the Ostenfeld collection from Yallingup Cave held at MEL and bearing Ostenfeld's identification of *T. calcitrapa* var, *pedunculata* Buchenau (see under *T. calcitrapa* var. *calcitrapa* above).

Triglochin calcitrapa var. *sessiliflora* Buchenau.

This name should be considered a synonym of the autonym *Triglochin calcitrapa* var. *calcitrapa*, *q.v.* above.

Triglochin isingiana (J.M.Black) Aston, *stat. nov.*

Triglochin calcitrapa Hook. var. *isingiana* J.M.Black, *Fl. S. Australia* edn 2 (1), 50 (1943). *T. elongata* Ising, *Trans. Roy. Soc. S. Australia* 56: 183 (1933), *nom. illeg., non* Buchenau (1903). Type citation: "*Central Australia*, Coglin Creek, August 26, 1931, No. 2,409".

Holotype: Coglin Creek, Central Australia, N.T., 26 Aug. 1931, *E.H.Ising 2409* (AD).

T. calcitrapa var. *pedunculata* Buchenau, *q.v.* above.

Black published *Triglochin calcitrapa* var. *isingiana* and cited it as a "n. comb." for Ising's name *T. elongata*, which Black realised was illegitimate. Eichler (1965) later pointed out that Black's name was a new varietal name, not a new combination. As Black explicitly indicated that his var. *isingiana* was a "n. comb.", it can be assumed that he was intending to create a new name (*nomen novum*) as an "avowed substitute" for Ising's illegitimate name. The type of Black's new varietal name, although not stated by Black, must be the type of the substituted name (McNeill *et al.*, 2006, Art. 7.3).

Black gave only "Diamentina River and Central Australia" for collections on which he based his variety, but although the collectors were not specified these two collections are readily identified in AD among the *ex herb.* J.M. Black material. There, two collections are mounted on the same sheet, the holotype (from Coglin Creek, Central Australia) and another collection (Flood plain of Diamentina River at Pandi Pandi, S.A. 18 Aug. 1934, *J.B. Cleland s.n.*), with relevant handwritten annotations by Black. The holotype has the characteristic fertile carpels each with all 4 basal spines and the basal membrane well-developed, as described by both Ising and Black. The fertile carpels of the additional Diamentina River collection used by Black have the 2 down-pointed spines and their connecting membrane near-absent.

The type sheet has been annotated by Hj.Eichler on 3 Dec. 1957 with "Coglin Creek is near Charlotte Waters and the locality where Mr Ising collected is near the railway line". This information would have been obtained by personal communication with Ising, and places the type locality approximately 25°55'S, 134°43'E.

Triglochin longicarpa (Ostenf.) Aston, *stat. nov.*

Triglochin centrocarpa var. *longicarpa* Ostenf., *Dansk Bot. Ark.* 2(8): 35 (1918).

Holotype: Watheroo Rabbit Fence, W.A., Sept. 1905, *M.Koch*; ?C *n.v.*; **isotype**: MEL, NSW, PERTH.

Ostenfeld wrote that the material of Koch's collection which he saw was "a specimen sent from the Nat. Herb. of New South Wales". This was apparently retained by Ostenfeld and should be in Copenhagen.

Triglochin racemosa Endl. in J.G.C.Lehmann, *Pl. Preiss.* 2: 54 (1846).

Lectotype: Rottnest Island, W.A., *s. dat., J.A.L.Preiss 2407*, LD; isolectotypes: M, MEL MO, *fide* E.M.Watson *Fl. Australia* 45: 470 (1987).

Endlicher described the species without seeing fruits, and his assignment of it to *Triglochin* was due to a misidentification. The name must be excluded from *Triglochin* and from Juncaginaceae. O.W.Sonder, *Linnaea* 28: 224 (1856), considered the species to be undeveloped *Anthericum semibarbatum* R.Br. [= *Bulbine semibarbata* (R.Br.) Haw., Liliaceae]. Watson, *loc. cit.*, agreed with Sonder's identification and gives 5 Aug. 1839 as the date of the Preiss collection.

Triglochin sp. *A* (as in Aston ms., for *Fl. Aust.* vol. 39)

Triglochin calcitrapa var. *sessiliflora* Buchenau in H.G.A.Engler, *Pflanzenr.* Heft 16, IV.14: 12 (1903), *pro parte*, as to Mt. Lyndhurst, S.A., 1898, *M. Koch 268* only (MEL, NSW), excluding lectotype (see above under *T. calcitrapa* var. *calcitrapa*).

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